

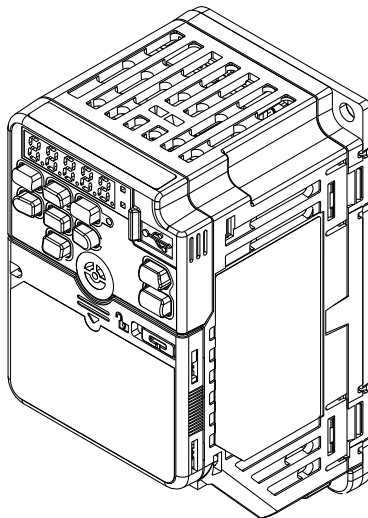
YASKAWA AC Drive GA500

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.



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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. Refer to the Technical Manual for more information about programming and parameter settings. 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	<i>This signal word identifies a hazard that will cause serious injury or death if you do not prevent it.</i>
 WARNING	<i>This signal word identifies a hazard that can cause death or serious injuries if you do not prevent it.</i>
 CAUTION	<i>Identifies a hazardous situation, which, if not avoided, can cause minor or moderate injury.</i>
 NOTICE	<i>This signal word identifies a property damage message that is not related to personal injury.</i>

◆ Section Safety

General Precautions
<ul style="list-style-type: none"> 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. The figures in this manual are examples only. All figures do not apply to all products included in this manual. Yaskawa can change the products, specifications, and content of the instructions without notice to make the product and/or the instructions better. 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.).

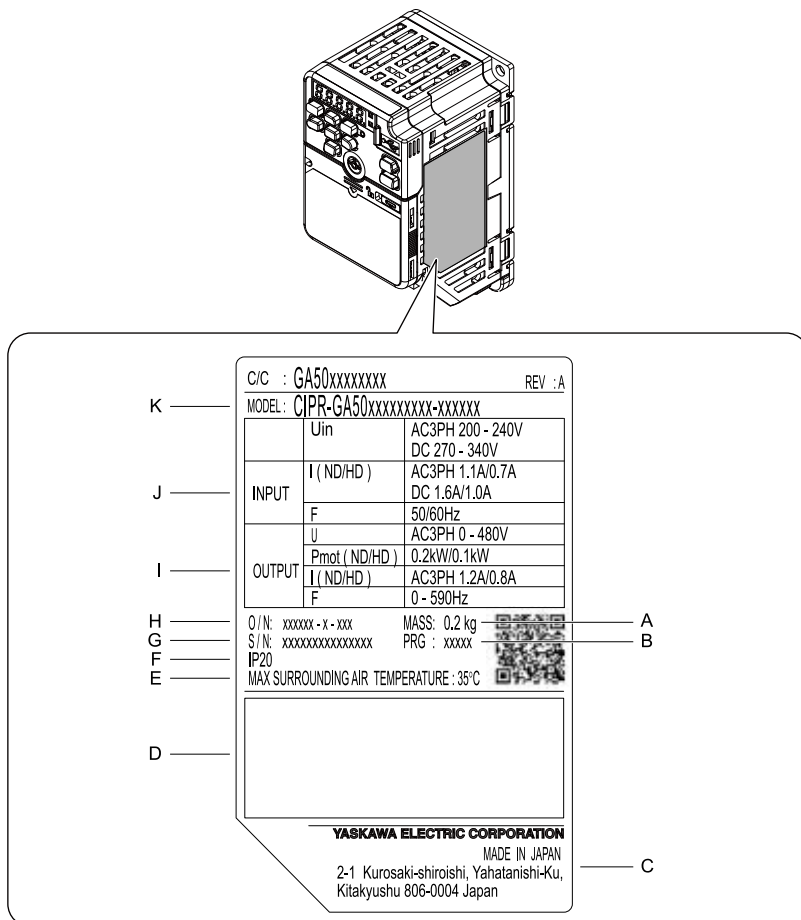
This manual shows you how to install the finless-type drive and obey the Conditions of Acceptability. Read and understand the safety information and precautions before you use the product.

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

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 <ul style="list-style-type: none">• A: Japan• B: China• C: Europe• T: Asia (Singapore, Taiwan, India, and Korea)• U: Americas
4	Input power supply voltage <ul style="list-style-type: none">• B: Single-Phase AC 200 V Class• 2: Three-Phase AC 200 V Class• 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) <ul style="list-style-type: none">• A: Standard (No built-in EMC filter)
7	Enclosure Protection Design <ul style="list-style-type: none">• J: Finless (IP20/UL Open Type)
8	Environmental specification <ul style="list-style-type: none">• A: Standard• K: Gas-resistant• M: Humidity-resistant and dust-resistant• N: Oil-resistant• P: Humidity-resistant, dust-resistant, and vibration-resistant• S: Vibration-resistant <p>Note: Drives with these specifications do not guarantee complete protection for the environmental conditions shown.</p>
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) <ul style="list-style-type: none"> • Drive reliability is better in environments where the temperature does not increase or decrease quickly. • 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. • Do not let the drive freeze. • You can use finless-type drives at a maximum of +50 °C (122 °F) when you derate the output current. */
Humidity	95%RH or less 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) Install the drive in an area without: <ul style="list-style-type: none"> • Oil mist, corrosive or flammable gas, or dust • Metal powder, oil, water, or other unwanted materials • Radioactive or flammable materials. • Harmful gas or fluids • Salt • Direct sunlight Keep wood and other flammable materials away from the drive.
Altitude	1000 m (3281 ft) Maximum Note: 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). It is not necessary to derate the rated voltage in these conditions: <ul style="list-style-type: none"> • When you install the drive at 2000 m (6562 ft) or lower • 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. Contact Yaskawa or your nearest sales representative if you will not ground the neutral point.
Vibration	<ul style="list-style-type: none"> • 10 Hz to 20 Hz: 1 G (9.8 m/s², 32.15 ft/s²) • 20 Hz to 55 Hz: 0.6 G (5.9 m/s², 19.36 ft/s²)
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.

00089

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%

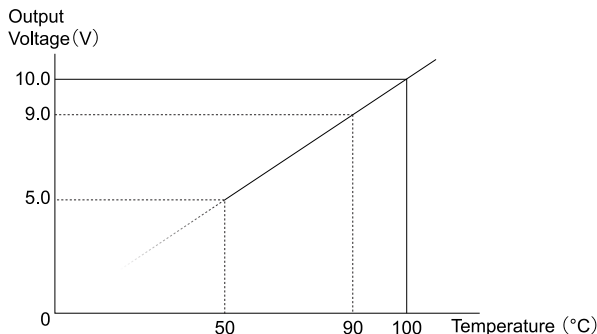


Figure 5.2 Heatsink Plate Temperature Output on MFAO

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 μ m and the maximum peak "Rz" is 25 μ m.

◆ 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 μ m - 250 μ m ^{*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.

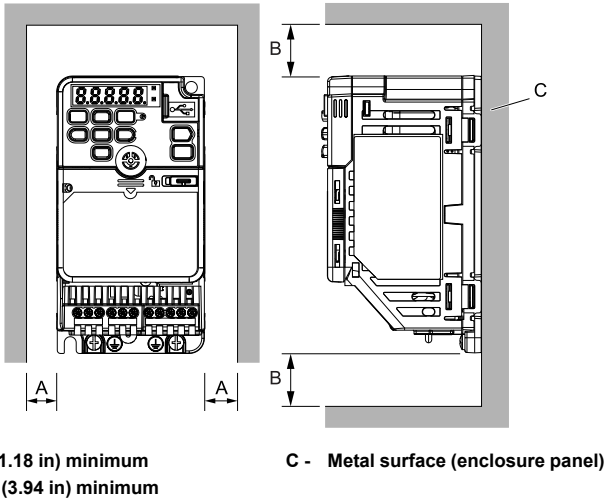


Figure 5.3 Installation Clearances

◆ **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

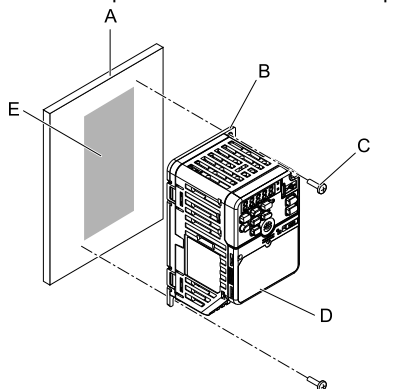
Drive Model	Screw Size	Tightening Torque N·m (lbf·in)
B001 - B012	M5	2.0 - 2.5 (17.7 - 22.1)
2001 - 2021	M5	2.0 - 2.5 (17.7 - 22.1)
4001 - 4012	M5	2.0 - 2.5 (17.7 - 22.1)

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 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 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.

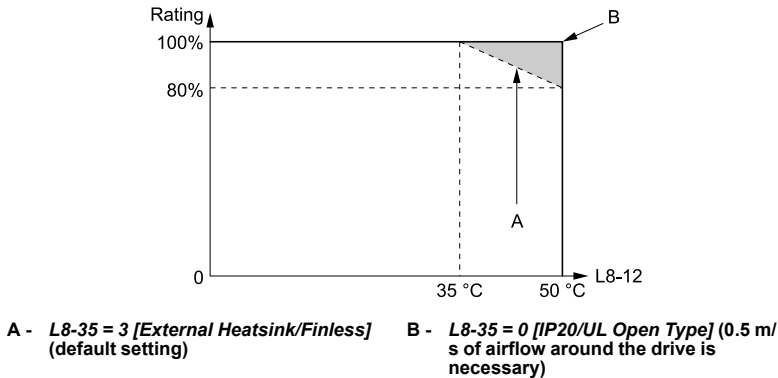


Figure 5.5 Derating Depending on Drive Installation Method

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 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

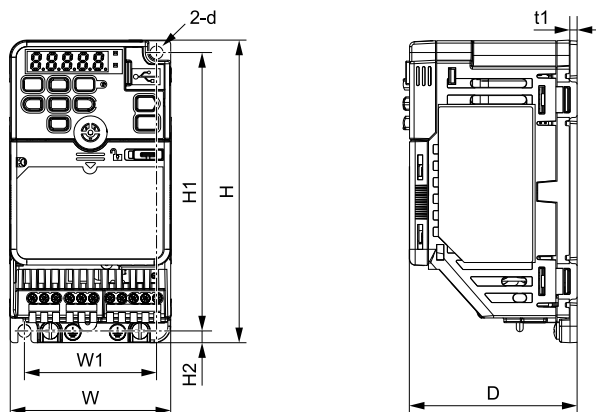


Figure 7.1 Exterior and Mounting Dimensions

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

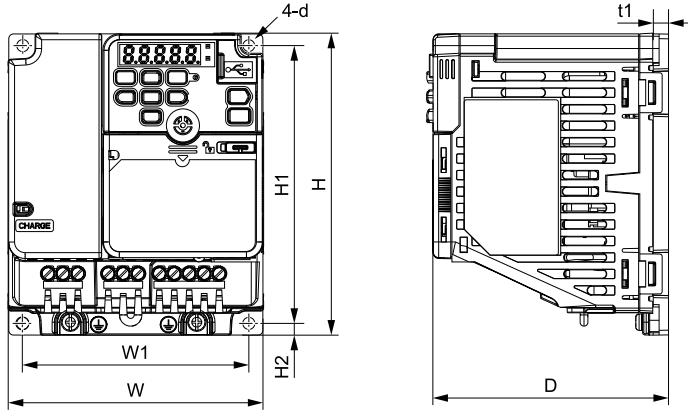


Figure 7.2 Exterior and Mounting Dimensions

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 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 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. <ul style="list-style-type: none"> • B001 - B012: 90 °C (194 °F) • 2001 - 2021: 90 °C (194 °F) • 4001 - 4012: 90 °C (194 °F)
T_{Amb}	Ambient temperature of the external heatsink
$R\theta_{HSP}$	Drive heatsink plate thermal resistance 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. $R\theta_{HSP-EHS} = \frac{d_{Comp}}{\lambda_{Comp} \cdot A_{th}}$
	A_{th} Heat transfer area between drive heatsink plate and external heatsink Note: 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. Use the H and W values of the drive exterior dimensions ^{*2} to calculate the area of the drive heatsink plate.
	λ_{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.

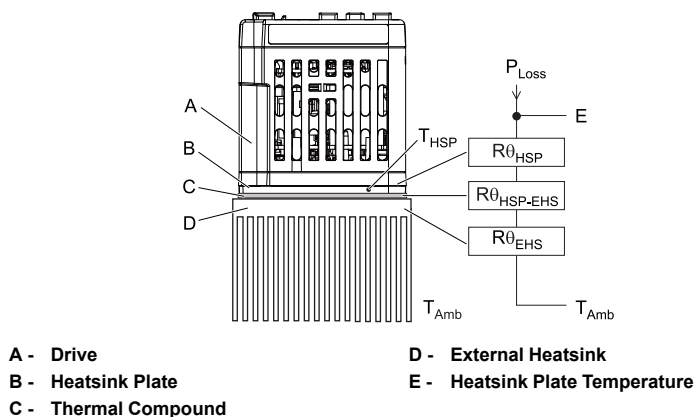


Figure 8.1 Thermal Equivalent Circuit Diagram

■ Select External Heatsink by Thermal Resistance

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

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

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 ($H \times W$). 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.

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

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	
$R\theta_{HSP-EHS}$	A_{th}	H = 128 mm D = 68 mm $A_{th} = 0.7 \times 0.128 \text{ m} \times 0.068 \text{ m} = 6.1 \times 10^{-3} \text{ m}^2$
	λ_{comp}	2.0 W/(m·K) Thermal conductivity of Oil-based compound X-23-7795 from Shin-Etsu Chemical Co., Ltd.
	d_{comp}	100 μm Recommended compound thickness (when applied)
	$R\theta_{HSP-EHS} = \frac{100 \text{ } \mu\text{m}}{2.0 \text{ W/(m}\cdot\text{K)} \times 6.1 \times 10^{-3} \text{ m}^2} = 0.008 \text{ K/W}$	

■ 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](#).

$$R\theta_{\text{EHS_max}} = \left(\frac{90\text{ }^{\circ}\text{C} - 40\text{ }^{\circ}\text{C}}{25.0\text{ W}} - 0.05\text{ K/W} - 0.008\text{ K/W} \right) = 1.94\text{ K/W}$$

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.

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

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 $R\theta_{\text{EHS}} = 1.1\text{ K/W}$ ($T_{\text{HSP}} = 68.95\text{ }^{\circ}\text{C}$).

Revision History

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YASKAWA AC Drive GA500

Finless-Type Drive Installation Manual

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