YASKAWA

YASKAWA AC Drive GA500

Finless-Type Drive

Installation Manual

Model: CIPR-GA50xxxxxAJxx
Type: 200 V Class, Single-Phase Input: 0.1 to 3.0 kW
200 V Class, Three-Phase Input: 0.1 to 18.5 kW
400 V Class, Three-Phase Input: 0.2 to 18.5 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.

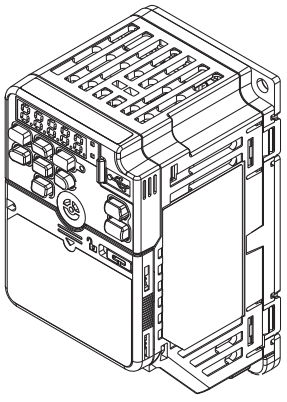
安川变频器GA500

无散热片型

设置要领说明书

型号: CIPR-GA50xxxxxAJxx
容量范围: 200 V级（单相电源用）0.1～3.0 kW
200 V级（三相电源用）0.1～18.5 kW
400 V级（三相电源用）0.2～18.5 kW

为了安全地使用产品，请务必阅读本书。另外，请妥善保管本书，同时务必将本书交到最终使用本产品的用户手中。



MANUAL NO. TOMP C710617 0SB

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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 *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 *This signal word 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. • 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.

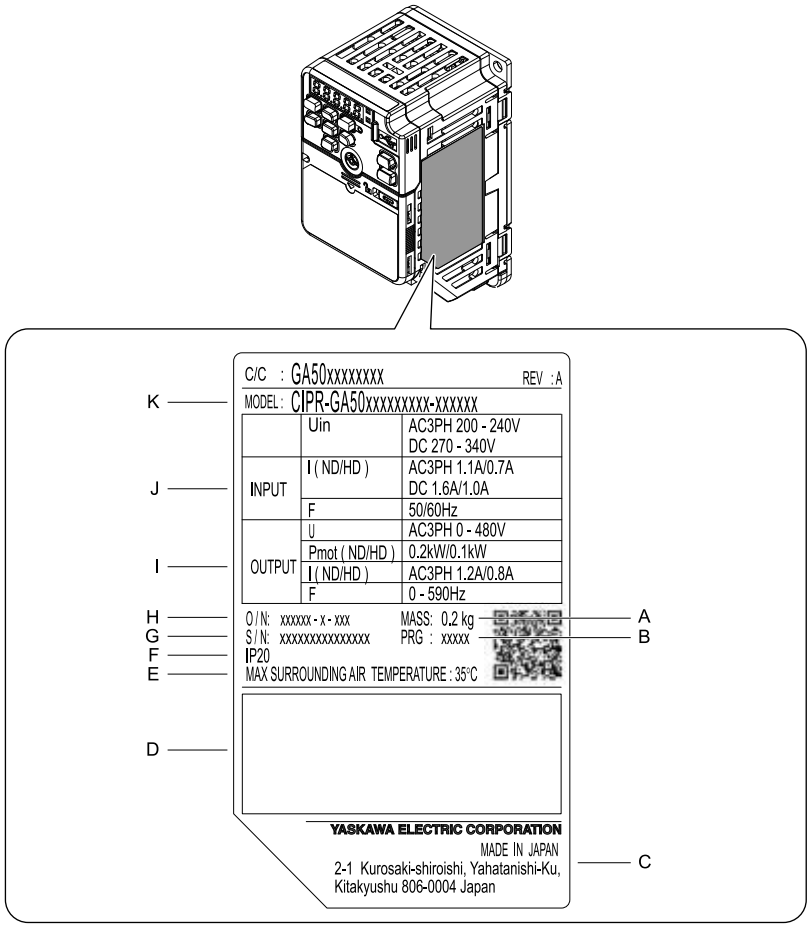
Finless-type drives are recognized components by UL (Underwriters Laboratories Inc.).

Machines and devices integrated with this product must satisfy *Conditions of Acceptability on page 30* conditions for compliance with UL standards.

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.

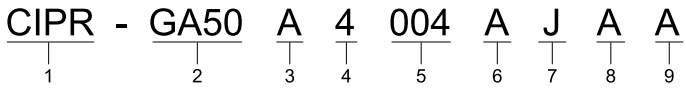


Figure 4.2 Drive Model

Table 4.1 Model Number Details

No.	Description
1	Drive
2	Product series
3	Region code • A: Japan • B: China • C: Europe • T: Asia (Singapore, Taiwan, India, and Korea) • U: Americas
4	Input power supply voltage • 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) • A: Standard (No built-in EMC filter)
7	Enclosure Protection Design • J: Finless (IP20/UL Open Type)
8	Environmental specification • 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 **Note:** 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, inside enclosure panel
Power Supply	Overvoltage Category III (IEC60664)
Ambient Temperature Setting	-10 °C to +35 °C (14 °F to 95 °F) • 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. *1*
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: • 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.

Environment	Conditions
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: • 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	• 10 Hz to 20 Hz: 1 G (9.8 m/s^2, 32.15 ft/s^2) • 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 20* 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 20* 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)
2030 - 2070	80 °C (176 °F)

Model	Maximum Temperature of the Heatsink Plate
4001 - 4012	90 °C (194 °F)
4018 - 4038	80 °C (176 °F)

Refer to *Drive Watt Loss on page 13* for the drive watt loss data.

Refer to *Monitor Heatsink Plate Temperature on page 11* 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%

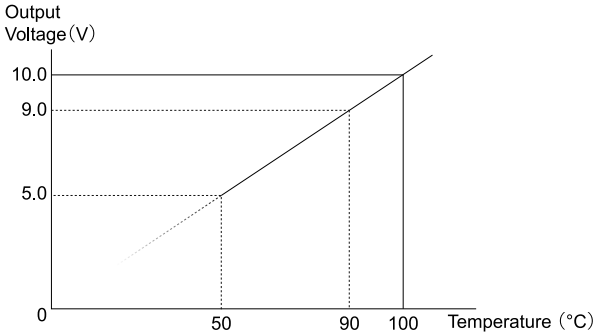


Figure 5.2 Heatsink Plate Temperature Output on MFAO

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

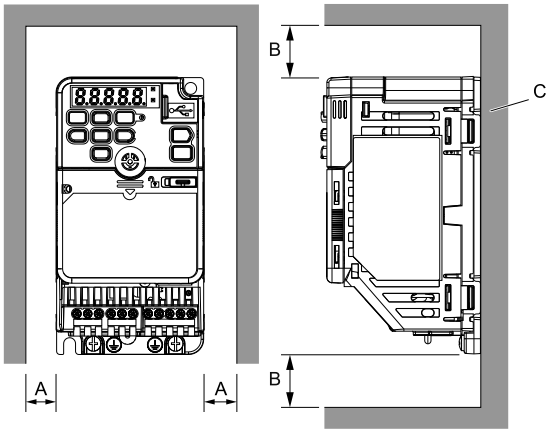
*1 The thickness can change with the condition of the metal surface.

◆ 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
2030	25.0	2	46	139	185
2042	33.0	2	67	175	242
2056	47.0	2	95	284	379
2070	60.0	2	157	377	534

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
4018	14.8	2	44	105	149

Drive Model	Rated Output Current (A)	Carrier Frequency (kHz)	Drive Watt Loss (W)		
			Interior Unit Loss	Heatsink Plate Loss (P_{Loss})	Total Loss
4023	18	2	76	146	220
4031	24	2	62	167	229
4038	31	2	89	222	311

■ 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
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

Drive Model	Rated Output Current (A)	Carrier Frequency (kHz)	Drive Watt Loss (W)		
			Interior Unit Loss	Heatsink Plate Loss (P_{Loss})	Total Loss
2018	14.0	8	30	82	112
2021	17.6	8	40	108	148
2030	25.0	8	50	163	214
2042	33.0	8	73	212	285
2056	47.0	8	108	347	455
2070	60.0	8	171	455	626

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
4018	14.8	8	52	149	201
4023	18	8	92	207	299
4031	24	8	75	240	315
4038	31	8	108	319	427

■ 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
2030	30	2	59	175	234
2042	42	2	101	250	351
2056	56	2	127	357	484
2070	70	2	202	455	657

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
4009	8.9	2	28	58	86
4012	11.9	2	39	83	122
4018	17.5	2	58	146	203
4023	23.4	2	81	204	286
4031	31	2	99	259	357
4038	38	2	141	319	460

◆ Screw Sizes and Tightening Torques

Table 5.14 shows the correct screw sizes and tightening torques 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)
2030 - 2056	M5	2.0 - 2.5 (17.7 - 22.1)
2070	M6	4.0 - 5.0 (35.4 - 44.3)

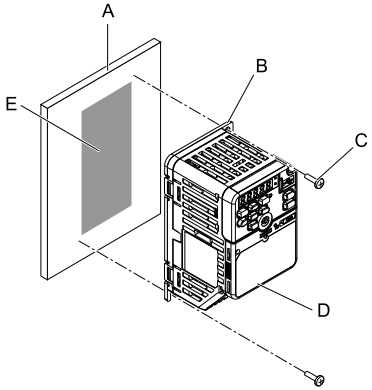
Drive Model	Screw Size	Tightening Torque N·m (lbf·in)
4001 - 4012	M5	2.0 - 2.5 (17.7 - 22.1)
4018 - 4038	M5	2.0 - 2.5 (17.7 - 22.1)

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

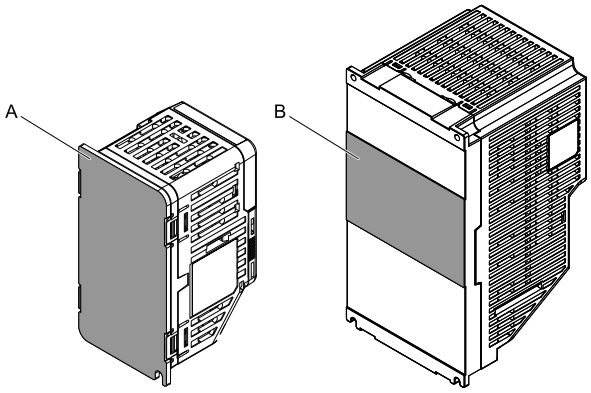
Apply the thermal compound across the full surface of the application area on the heatsink. Tightly push the drive against the metal surface (enclosure panel).

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



A - Metal surface (enclosure panel)
B - Heatsink plate
C - Screws
D - Finless-type drive
E - Drive mounting area

Figure 5.4 Install the Drive



A - Application area (B001 to B012, 2001 to 2021, 4001 to 4012)

B - Application area (2030 to 2070, 4018 to 4038)

Figure 5.5 Thermal Compound Application Area

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 5.6.

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.

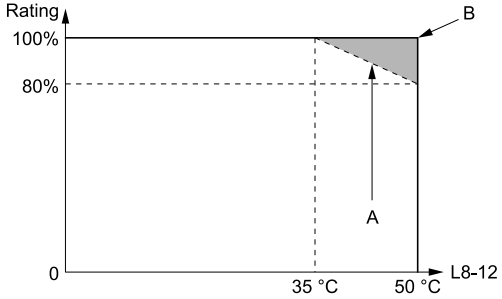
2 : IP20/UL Type 1

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.



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 5.6 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

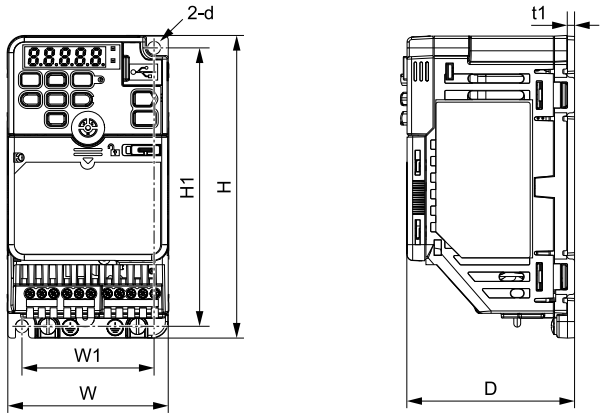


Figure 7.1 Exterior and Mounting Dimensions

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

Model	Dimensions mm (in)							Est. Weight
	W	H	D	W1	H1	t1	d	kg (lb)
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

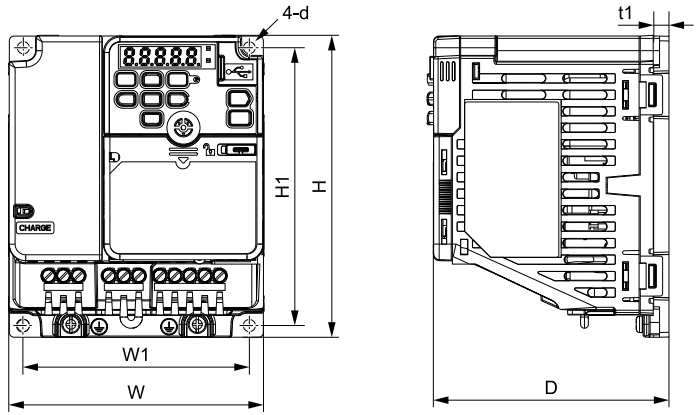


Figure 7.2 Exterior and Mounting Dimensions

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)

Model	Dimensions mm (in)							Est. Weight kg (lb)
	W	H	D	W1	H1	t1	d	
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)

◆ 2030 - 2070, 4018 - 4038

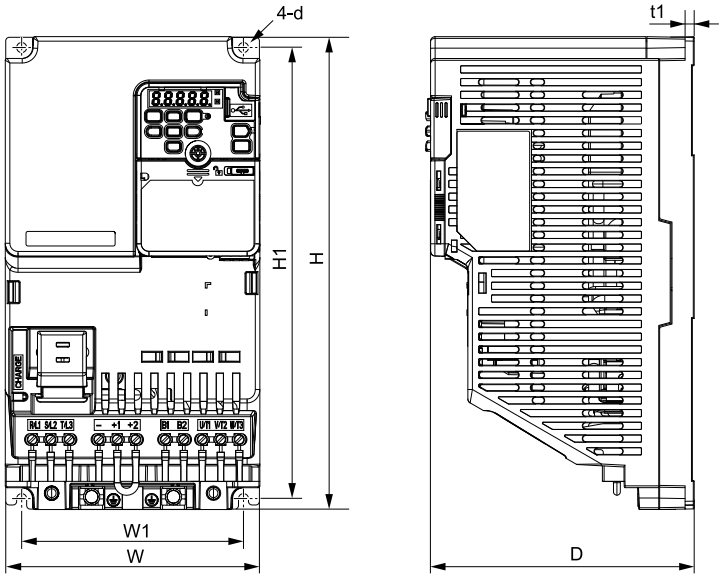


Figure 7.3 Exterior and Mounting Dimensions

Table 7.6 Three-Phase 200 V Class (Finless-Type Drive)

Model	Dimensions mm (in)							Est. Weight kg (lb)
	W	H	D	W1	H1	t1	d	
2030	140 (5.51)	260 (10.24)	145 (5.71)	122 (4.80)	248 (9.76)	5 (0.20)	M5	2.9 (6.39)
2042	140 (5.51)	260 (10.24)	145 (5.71)	122 (4.80)	248 (9.76)	5 (0.20)	M5	3.1 (6.83)
2056	180 (7.09)	300 (11.81)	147 (5.79)	160 (6.30)	284 (11.18)	5 (0.20)	M5	4.5 (9.92)
2070	220 (8.66)	350 (13.78)	152 (5.98)	192 (7.56)	336 (13.23)	5 (0.20)	M6	6.0 (13.23)

Table 7.7 Three-Phase 400 V Class (Finless-Type Drive)

Model	Dimensions mm (in)							Est. Weight kg (lb)
	W	H	D	W1	H1	t1	d	
4018	140 (5.51)	260 (10.24)	145 (5.71)	122 (4.80)	248 (9.76)	5 (0.20)	M5	2.6 (5.73)
4023	140 (5.51)	260 (10.24)	145 (5.71)	122 (4.80)	248 (9.76)	5 (0.20)	M5	2.8 (6.17)
4031	180 (7.09)	300 (11.81)	147 (5.79)	160 (6.30)	284 (11.18)	5 (0.20)	M5	4.1 (9.04)
4038	180 (7.09)	300 (11.81)	147 (5.79)	160 (6.30)	284 (11.18)	5 (0.20)	M5	4.3 (9.48)

8 External Heatsink Selection

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

◆ Necessary Data for External Heatsink Selection

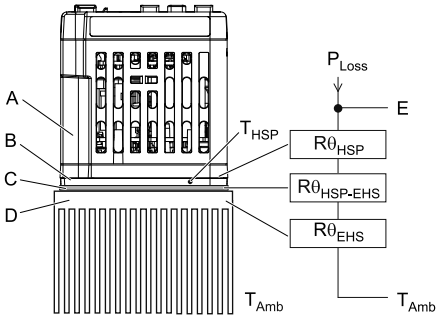
Symbol	Description	
P_{Loss}	Drive heatsink watt loss (W) *1	
T_{HSP_max}	Maximum heatsink plate temperature This is the temperature at the surface of the heatsink plate. Set *U4-08 [Heatsink Temperature]* to monitor the drive heatsink temperature. Maximum temperatures are different for different models. • B001 - B012: 90 °C (194 °F) • 2001 - 2021: 90 °C (194 °F) • 2030 - 2070: 80 °C (176 °F) • 4001 - 4012: 90 °C (194 °F) • 4018 - 4038: 80 °C (176 °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 13* for information.
*2 Refer to *Drive Exterior and Mounting Dimensions on page 22* 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 11* 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 D = 68 mm $A_{th} = 0.7 \times 0.128\ m \times 0.068\ m = 6.1 \times 10^{-3}\ m^2$
	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)
	$R\theta_{HSP_EHS} = \frac{100\ \mu m}{2.0\ W/(m \cdot K) \times 6.1 \times 10^{-3}\ m^2} = 0.008$ 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 28*.

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

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).

9 Conditions of Acceptability

Machines and devices integrated with this product must satisfy the following conditions for compliance with UL standards.

Refer to the manuals packaged with the drive for additional UL compliance requirements.

1. Install finless-type drives into a ventilated enclosure with a minimum enclosure volume shown in Table 9.1.

Table 9.1 Minimum Enclosure Volume

Model	Minimum Volume cm³ (in³)
B001 - B006 2001 - 2012	9850 (600)
B010 - B012 2018 - 2042 4001 - 4023	15750 (960)
2056 - 2070 4031, 4038	42000 (2560)

2. Keep the ambient temperature lower than 35 °C (95 °F) in your application.
3. Keep the drive heatsink plate temperature lower than the maximum temperature shown in Table 9.2 in your application.
   Use *U4-08 [Heatsink Temperature]* to monitor the drive heatsink temperature.

Table 9.2 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)
2030 - 2070	80 °C (176 °F)
4001 - 4012	90 °C (194 °F)
4018 - 4038	80 °C (176 °F)

4. 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
5. Make sure that there is sufficient space for wiring and airflow to cool the drive.
   - 30 mm (1.18 in) minimum from each side
   - 100 mm (3.94 in) minimum from top and bottom
6. The recommended thermal compound is X-23-7795 from Shin-Etsu Chemical Co., Ltd. Apply 100 µm to 250 µm of thermal compound over the full heatsink plate of the drive.
7. Use the correct screws to safety the drive to a metal surface (enclosure panel). Table 9.3 shows the screw sizes and tightening torques.
   Monitor the temperature of the external heatsink at the top center of the junction between the external heatsink and the drive.

Table 9.3 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)
2030 - 2056	M5	2.0 - 2.5 (17.7 - 22.1)

Drive Model	Screw Size	Tightening Torque N·m (lbf·in)
2070	M6	4.0 - 5.0 (35.4 - 44.3)
4001 - 4012	M5	2.0 - 2.5 (17.7 - 22.1)
4018 - 4038	M5	2.0 - 2.5 (17.7 - 22.1)

Revision History

Date of Publication	Revision Number	Section	Revised Content
September 2021	1	5, 7, 8	Addition: Larger drive capacities added along with corresponding data. • Three-Phase 200 V Class: CIPR-GA50x2030 to 2070 • Three-Phase 400 V Class: CIPR-GA50x4018 to 4038
		9	Addition: "Conditions of Acceptability"
November 2020	-	-	First Edition

YASKAWA AC Drive GA500

Finless-Type Drive

Installation Manual

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In the event that the end user of this product is to be the military and said product is to be employed in any weapons systems or the manufacture thereof, the export will fall under the relevant regulations as stipulated in the Foreign Exchange and Foreign Trade Regulations. Therefore, be sure to follow all procedures and submit all relevant documentation according to any and all rules, regulations and laws that may apply.

Specifications are subject to change without notice for ongoing product modifications and improvements.

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Original instructions.

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1 使用前确认事项

◆ 相关使用说明书

资料	内容
安川变频器 GA500 无散热片型 设置要领说明书	对无散热片型GA500的安装方法进行说明。
安川变频器 使用说明书	变频器的基本信息请参见变频器同箱包装的说明书。 关于参数的详细信息请参见技术手册。 技术手册可以从本书封底标示的本公司官网下载。

◆ 关于本书中的术语、简称

书中所用术语	说明
变频器	安川变频器 GA500无散热片型

2 安全使用注意事项

◆ 与安全有关的标识

⚠ 危险 **如果操作错误，极有可能会导致死亡或重伤。**

⚠ 警告 **如果操作错误，可能会导致死亡或重伤。**

⚠ 注意 **如果操作错误，可能会导致轻伤。**

提示 **如果操作错误，可能会损坏设备。**

◆ 安全注意事项

一般注意事项
• 为了说明产品的细节，本书中关于变频器或选购机器的图解有时为拆下外罩或安全遮盖物的状态。操作产品时，请务必按规定将外罩或遮盖物装回原位。使用变频器或选购机器时，请务必按本书的规定操作。 • 本书中使用的图例仅为代表示例。并非所有的图都涵盖书中罗列的全部容量的变频器。 • 为了提高产品和本书的使用便利性，可能会改进产品、变更规格以及修订本书内容，恕不另行通知。 • 因破损或丢失需要索取本书时，请联系本公司代理商或本书封底标注的离您最近的分公司，届时请告知封面的资料编号。

3 概要

普通变频器的主要发热体为散热片，本变频器没有散热片。本变频器将控制柜（金属板）作为散热片使用，将变频器产生的热量向外散出。因为没有散热片，因此可以将本变频器收容在体积较小的控制柜中。

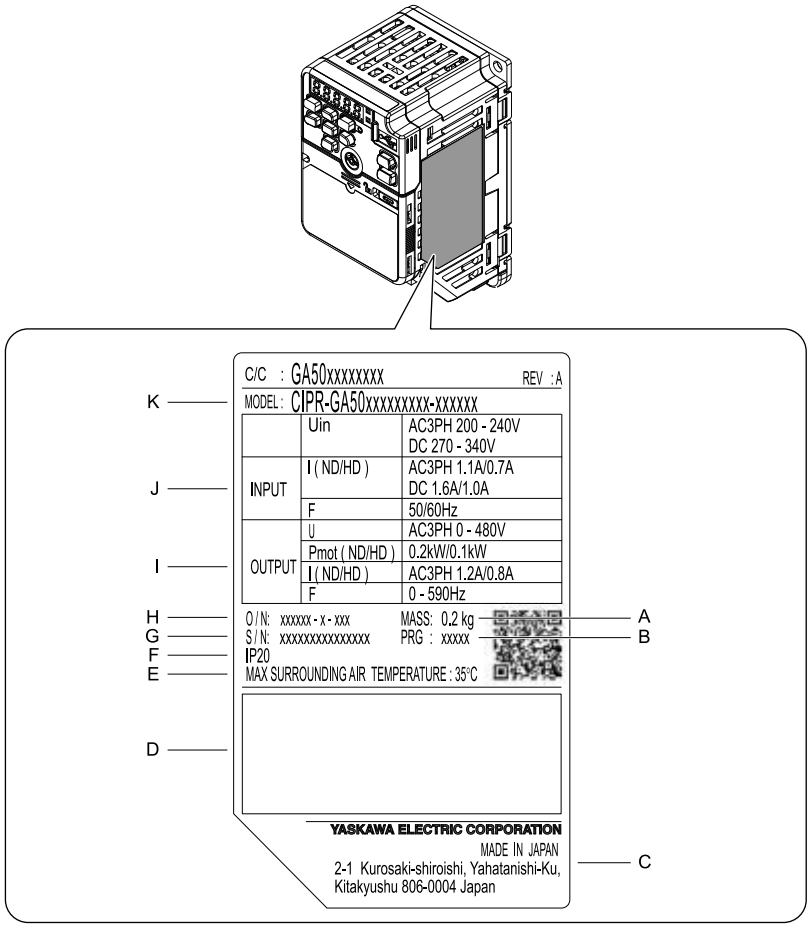
无散热片型变频器为UL（Underwriters Laboratories Inc.）认证产品（Recognized Component）。

为了使使用本产品的机械及装置支持UL标准，需满足「支持*UL*标准所需的使用条件*(Conditions of Acceptability)*」（29 页）所示的条件。

4 使用前确认事项

1. 请确认产品是否有损伤或缺少零部件。产品发生损伤时，请立即与运输公司联系。产品搬运时造成的损伤不属于本公司的保证范围。
2. 请确认变频器的型号是否与您订购的产品一致。型号请参阅变频器侧面铭牌上的“MODEL”栏。
3. 如果发现产品有不良状况，请立即与您购买产品的代理商或本公司销售部门联系。
4. 使用多台变频器的系统，应对所有的变频器和电机分别进行确认。

提示 **为了防止机器损坏：请勿运行已经损坏的机器。如果机器明显损坏或者有部件丢失，请勿连接或进行操作。否则会加剧机器的损坏。**



A - 质量
B - 软件版本
C - （株）安川電機母公司所在地
D - 支持标准的标志
E - 环境温度规格
F - 保护等级
G - 制造编号
H - 批号
I - 输出规格
J - 输入规格
K - 变频器的型号

图 4.1 铭牌的位置

◆ 型号的查阅方法

变频器的型号的查阅方法如图 4.2以及表 4.1所示。

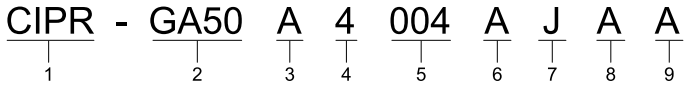


图 4.2 变频器的型号

表 4.1 型号的详细

No.	详细内容
1	变频器
2	产品系列
3	销往地区 • A：日本 • B：中国 • C：欧洲 • T：亚洲（新加坡、台湾、印度、韩国） • U：美洲
4	输入电源电压等级 • B：单相AC200 V级 • 2：三相AC200 V级 • 4：三相AC400 V级
5	额定输出电流
6	EMC噪音滤波器（无散热片型变频器中无内置EMC滤波器） • A：标准（无内置EMC滤波器）
7	保护等级 • J：无散热片型（IP20/UL Open型）
8	耐环境性改善规格 • A：标准 • K：防气蚀 • M：防潮、防尘 • N：防油 • P：防潮、防尘、防振 • S：防振 （注） 即使是耐环境性改善规格的变频器，也不能完全保证可以在这些环境中使用。
9	设计顺序

5 使用条件

为了充分发挥无散热片型变频器的性能，安装变频器时请务必遵守以下条件。

◆ 安装环境

为了充分发挥本产品的性能，确保长期使用，安装环境非常重要。请将变频器安装在表5.1所示的环境中。

表 5.1 安装环境

环境	条件
安装场所	控制柜内
电源	过电压等级Ⅲ(IEC60664)
环境温度	-10 °C～+35 °C（14 °F～95 °F） • 为了提高机器的可靠性，请在温度不会急剧变化的场所使用本产品。 • 在控制柜等封闭的空间内使用时，请使用冷却风扇或冷却空调进行冷却，以避免内部温度超过条件温度。 • 请避免使变频器冻结。 • 如果降低输出电流，可以在+50 °C （122 °F)环境下使用。 *1
湿度	95%RH以下 请避免使变频器结露。
保存温度	-20°C～+70°C （-4 °F～+158 °F）（运输期间等短时间内的温度）
环境	污染度2以下(IEC 60664-1) 请将变频器安装在如下场所。 • 无油雾、腐蚀性气体、易燃性气体、尘埃等的场所 • 变频器内部不得进入金属粉末、油、水等异物。 • 无放射性物质、易燃物的场所 • 无有害气体及液体的场所 • 盐蚀少的场所 • 无阳光直射的场所 请勿将变频器安装在木材等易燃物的上面。
海拔高度	1000 m （3281 ft）以下 （注） 如果在海拔高度1000 m（3281 ft）至4000 m（13123 ft）的场所使用，每升高100 m （328 ft）就要降低1%的额定输入。 下述场合不需要降低额定电压。 • 海拔高度2000 m（6562 ft）以下 • 海拔高度2000 m（6562 ft）至4000 m（13123 ft）之间，但电源电压中性点接地 中性点不接地时，请向本公司代理商或销售负责人垂询。

环境	条件
耐振	• 10～20 Hz（不含）:1 G（9.8 m/s², 32.15 ft/s²） • 20～55 Hz（不含）:0.6 G（5.9 m/s², 19.36 ft/s²）
安装方向	为了避免冷却效果下降，请务必进行纵向安装。

*1 请参照「根据环境温度降低额定值」（20 页）。

提示 **请勿在变频器周围安装变压器等产生电磁波或干扰的设备。如需安装此类设备，应在其与变频器之间设置屏蔽板。受噪音影响，变频器外围机器可能会发生误动作。**

提示 **为了防止机器损坏：安装变频器时，请勿使钻头上的金属屑、电线头、油、水等进入变频器内部。安装变频器时，请用布或纸张暂时盖住变频器上部。在运行变频器之前，请去除这些布或纸张。如果异物进入变频器内部，可能导致变频器损坏。**

◆ 散热片固定板温度

⚠ 注意 **为了防止烫伤：请勿触摸变频器的散热片固定板和外部散热器。建议在外部散热器上标示当心高温的警告标志或标语。变频器的散热片固定板以及外部散热器会产生高温，有导致烫伤的危险。**

即使环境温度为50 °C（122 °F），也请使散热片固定板的温度不要超过上限。散热片固定板的温度上限请参照表 5.2。如果环境温度超过了35 °C（95 °F），请参照「根据环境温度降低额定值」（20 页），降低额定使用。

表 5.2 散热片固定板的温度上限

型号	温度上限
B001～B012	90 °C（194 °F）
2001～2021	90 °C（194 °F）
2030～2070	80 °C（176 °F）
4001～4012	90 °C（194 °F）
4018～4038	80 °C（176 °F）

变频器的发热量请参照「变频器的发热量」（13 页）。

变频器散热片固定板的温度的确认方法请参照「确认散热片固定板温度」（10 页）。

■ 确认散热片固定板温度

- 使用操作器时
  设定参数U4-08［散热片温度］后，会显示散热片固定板温度。



图 5.1 U4-08［散热片温度］（散热片固定板89 °C时）

- 使用多功能模拟量监视输出时
  使用端子AM时，如表 5.3所示设定参数。

表 5.3 多功能模拟量监视输出的设定

参数	名称	设定
H4-01	端子AM监视选择	408（U4-08）
H4-02	端子AM监视增益	100.0%
H4-03	端子AM监视偏置	0.0%

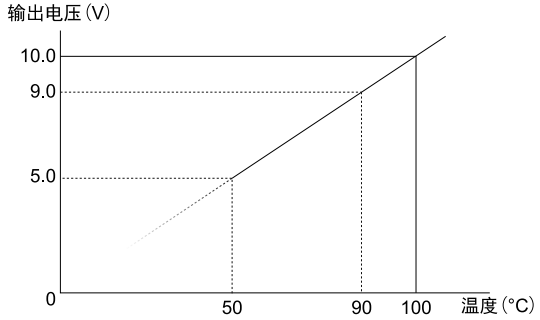


图 5.2 多功能模拟量监视输出的散热片固定板的温度输出

（注） • 散热片固定板温度在50 °C～100 °C（122 °F～212 °F）区间时，精度为±5 °C（41 °F）。
• 还需要考虑因安装环境导致的温度变化。

■ oH预警检出基准

如果温度超过L8-02［oH预警检出基准］的设定值，变频器会检出oH［散热片过热］。要使本功能有效，需将H2-0x［多功能接点输出端子的功能选择］中的任意一个设定为20［oH预警］。

通过L8-03［oH预警动作选择］设定变频器检出oH［散热片过热］时的动作。

详情请参照GA500技术手册。。

◆ 安装面的平整加工

安装变频器的金属面必须满足以下条件。

- 平整度：0.2 mm（0.0078 in）以下
- 表面粗糙度：25 S以下

（注） 表面粗糙度25 S是指轮廓偏距绝对值算数平均值为6.3 a，轮廓峰高谷底平均值为25 μm。

◆ 导热硅脂

导热硅脂可以使发热体和散热器紧密贴合，从而提高热传导率。

请在变频器的散热片固定板间涂抹导热硅脂。不同的散热器最匹配的导热硅脂也不同。选择使用导热硅脂时请咨询生成厂商。

导热硅脂的选择示例如表 5.4所示，仅做参考。

表 5.4 导热硅脂选择示例

厂商	类型	型号	涂抹量的标准 （导热硅脂涂层厚度）
信越化学工业（株）	硅油导热硅脂	X-23-7795	100 μm～250 μm *1

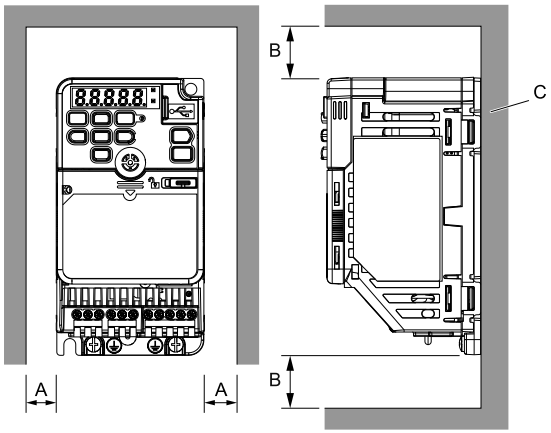
*1 导热硅脂涂层的厚度因金属面的平整状况而异。

◆ 安装空间

为了确保变频器冷却所需的通气空间及接线空间，请务必遵守图 5.3中所示的安装条件。

为了使变频器和金属面间能够充分进行热传导，请将变频器散热片固定板紧贴着金属板（控制柜）安装。

（注） 无散热片型变频器不能并列紧凑安装。



A - 30 mm (1.18 in.)以上
B - 100 mm (3.94 in.)以上
C - 金属面（控制柜）

图 5.3 变频器的安装空间

◆ 变频器的发热量

■ 重载额定（HD）：载波频率为2 kHz时

表 5.5 单相200V级(无散热片型)

变频器型号	额定输出电流（A）	载波频率（kHz）	发热量（W）		
			单元内部	散热片固定板（P_{Loss}）	总发热量
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

表 5.6 三相200V级(无散热片型)

变频器型号	额定输出电流（A）	载波频率（kHz）	发热量（W）		
			单元内部	散热片固定板（P_{Loss}）	总发热量
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
2030	25.0	2	46	139	185
2042	33.0	2	67	175	242

变频器型号	额定输出电流（A）	载波频率（kHz）	发热量（W）		
			单元内部	散热片固定板（P_{Loss}）	总发热量
2056	47.0	2	95	284	379
2070	60.0	2	157	377	534

表 5.7 三相400V级(无散热片型)

变频器型号	额定输出电流（A）	载波频率（kHz）	发热量（W）		
			单元内部	散热片固定板（P_{Loss}）	总发热量
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
4018	14.8	2	44	105	149
4023	18	2	76	146	220
4031	24	2	62	167	229
4038	31	2	89	222	311

■ 重载额定（HD）：载波频率为出厂设定时

表 5.8 单相200V级(无散热片型)

变频器型号	额定输出电流（A）	载波频率（kHz）	发热量（W）		
			单元内部	散热片固定板（P_{Loss}）	总发热量
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

变频器型号	额定输出电流（A）	载波频率（kHz）	发热量（W）		
			单元内部	散热片固定板（P_{Loss}）	总发热量
B010	8	8	31	42	73
B012	11	8	41	55	96

表 5.9 三相200V级(无散热片型)

变频器型号	额定输出电流（A）	载波频率（kHz）	发热量（W）		
			单元内部	散热片固定板（P_{Loss}）	总发热量
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
2030	25.0	8	50	163	214
2042	33.0	8	73	212	285
2056	47.0	8	108	347	455
2070	60.0	8	171	455	626

表 5.10 三相400V级(无散热片型)

变频器型号	额定输出电流（A）	载波频率（kHz）	发热量（W）		
			单元内部	散热片固定板（P_{Loss}）	总发热量
4001	1.2	8	9	11	20
4002	1.8	8	11	16	27
4004	3.4	8	15	31	46

变频器型号	额定输出电流（A）	载波频率（kHz）	发热量（W）		
			单元内部	散热片固定板（P_{Loss}）	总发热量
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
4018	14.8	8	52	149	201
4023	18	8	92	207	299
4031	24	8	75	240	315
4038	31	8	108	319	427

■ 轻载额定(ND)

表 5.11 单相200V级(无散热片型)

变频器型号	额定输出电流（A）	载波频率（kHz）	发热量（W）		
			单元内部	散热片固定板（P_{Loss}）	总发热量
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

表 5.12 三相200V级(无散热片型)

变频器型号	额定输出电流（A）	载波频率（kHz）	发热量（W）		
			单元内部	散热片固定板（P_{Loss}）	总发热量
2001	1.2	2	7	5	12
2002	1.9	2	9	9	18
2004	3.5	2	11	16	27

变频器型号	额定输出电流（A）	载波频率（kHz）	发热量（W）		
			单元内部	散热片固定板（P_{Loss}）	总发热量
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
2030	30	2	59	175	234
2042	42	2	101	250	351
2056	56	2	127	357	484
2070	70	2	202	455	657

表 5.13 三相400V级(无散热片型)

变频器型号	额定输出电流（A）	载波频率（kHz）	发热量（W）		
			单元内部	散热片固定板（P_{Loss}）	总发热量
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
4009	8.9	2	28	58	86
4012	11.9	2	39	83	122
4018	17.5	2	58	146	203
4023	23.4	2	81	204	286
4031	31	2	99	259	357
4038	38	2	141	319	460

◆ 安装螺丝尺寸和紧固力矩

将变频器固定到金属壁面(控制柜)的螺丝尺寸和紧固力矩如表 5.14所示。

表 5.14 安装螺丝尺寸和紧固力矩

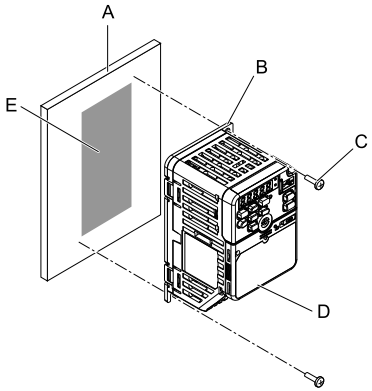
变频器型号	螺丝尺寸	紧固力矩 N·m (lbf·in)
B001～B012	M5	2.0～2.5 (17.7～22.1)
2001～2021	M5	2.0～2.5 (17.7～22.1)
2030～2056	M5	2.0～2.5 (17.7～22.1)
2070	M6	4.0～5.0 (35.4～44.3)
4001～4012	M5	2.0～2.5 (17.7～22.1)
4018～4038	M5	2.0～2.5 (17.7～22.1)

提示 **为了防止机器损坏：请按紧固力矩来紧固螺丝。如果紧固力矩不足，会有导致变频器过热而造成损坏的危险。**

◆ 安装变频器

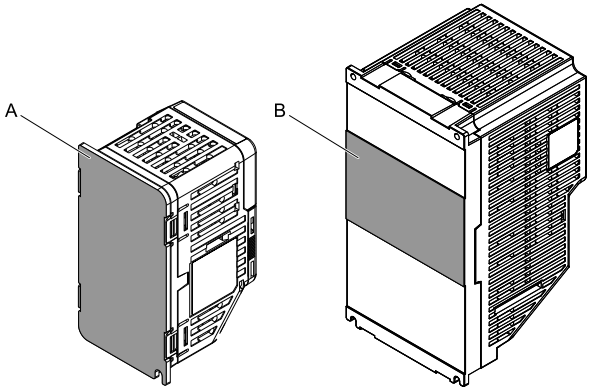
按压变频器到金属壁面（控制柜），以使导热硅脂扩散覆盖到变频器散热片固定板的全部涂抹区。

请将溢出的导热硅脂擦拭干净。



A - 金属壁面（控制柜）
B - 散热片固定板
C - 螺丝
D - 无散热片型变频器
E - 变频器安装位置

图 5.4 变频器的安装



A - 涂抹面(B001～B012，2001～2021，4001～4012)
B - 涂抹面(2030～2070，4018～4038)

图 5.5 导热硅脂的涂抹面

（注） 如果想尽量少涂抹导热硅脂，请使用铣刀加工安装金属面提高平整度。建议平整度小于等于 0.05 mm（0.00197 in）。即使使用铣刀加工了金属面，也要缓慢地将变频器压在金属面（控制柜）上。

◆ 根据环境温度降低额定值

如果变频器的安装场所的环境温度高于额定条件，请设定参数L8-12［环境温度］和L8-35［装置安装方法选择］。输出电流请按照图 5.6所示降低额定值。

No. （Hex.）	名称	内容	出厂设定 （设定范围）
L8-12 (04B8)	环境温度	V/f OLV OLV/PM AOLV/PM EZOLV 设定变频器安装场所的环境温度。	40°C (-10 °C - +60 °C)

No. （Hex.）	名称	内容	出厂设定 （设定范围）
L8-35 (04EC)	装置安装方法选择	V/f OLV OLV/PM AOLV/PM EZOLV 设定变频器的安装方法。	3 (0 - 3)

0 : IP20/UL Open型

请在安装IP20/UL Open型变频器时设定此值。

请确保变频器之间或变频器与控制柜的侧面相隔30 mm (1.18 in)以上。

1 : 并列安装

请在多台变频器并列紧凑安装时设定此值。

无散热片型变频器不能并列紧凑安装。

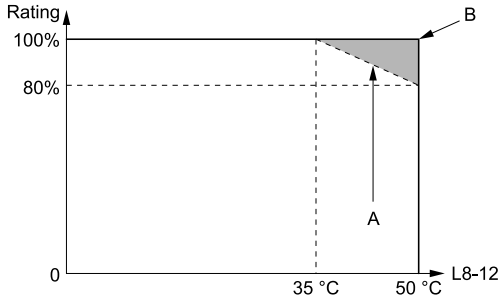
2 : IP20/UL Type 1

请在安装IP20/UL Type 1变频器时设定此值。

无散热片型变频器不能安装IP20/UL Type 1选购配件。

3 : 散热片外置 / 无散热片

请在安装散热片外置或无散热片型变频器时设定此值。



A - L8-35 = 3［散热片外置 / 无散热片］（出厂设定）　B - L8-35 = 0［IP20/UL Open型］（变频器周围有0.5 m/s的气流时）

图 5.6 根据变频器的安装方法降低额定值

6 维护

◆ 部件更换标准

定期更换部件的标准更换年限如表 6.1所示。更换部件时，请使用与所用变频器的型号和设计顺序相符的本公司的部件。

表 6.1 标准更换年限

部件	标准更换年限
电解电容	10年 *1

*1　如果无法修理或更换的部位发生破损，请更换整个变频器。

（注） 标准更换年限以下述使用条件为前提。标准更换年限仅为大致标准，并不保证产品的使用寿命。标准更换年限可能会因安装环境和使用情况而变短。

- 环境温度：年平均35 °C（95 °F）
- 负载率：80%
- 运行率：24小时

7 变频器外形图

◆ B001～B004、2001～2006

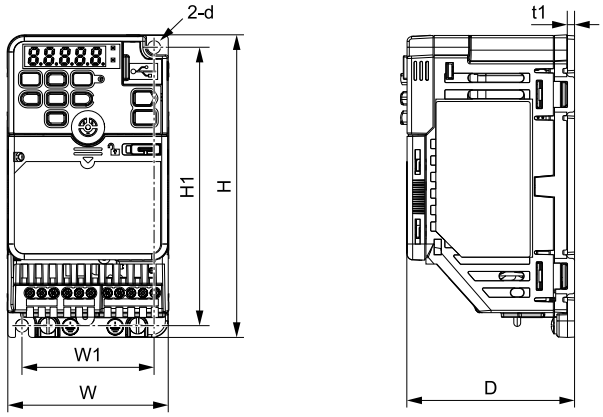


图 7.1 外形图

表 7.1 单相200V级(无散热片型)

型号	尺寸 mm (in)							毛重 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)

表 7.2 三相200V级(无散热片型)

型号	尺寸 mm (in)							毛重 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)

型号	尺寸 mm (in)							毛重 kg (lb)
	W	H	D	W1	H1	t1	d	
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～B012、2008～2021、4001～4012

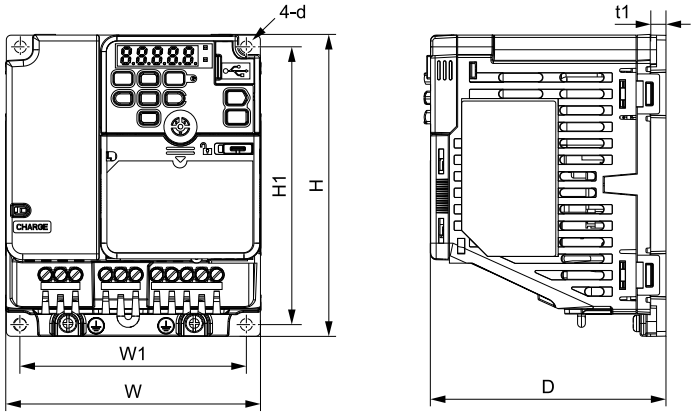


图 7.2 外形图

表 7.3 单相200V级(无散热片型)

型号	尺寸 mm (in)							毛重 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)

表 7.4 三相200V级(无散热片型)

型号	尺寸 mm (in)							毛重 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)

表 7.5 三相400V级(无散热片型)

型号	尺寸 mm (in)							毛重 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)

◆ 2030～2070、4018～4038

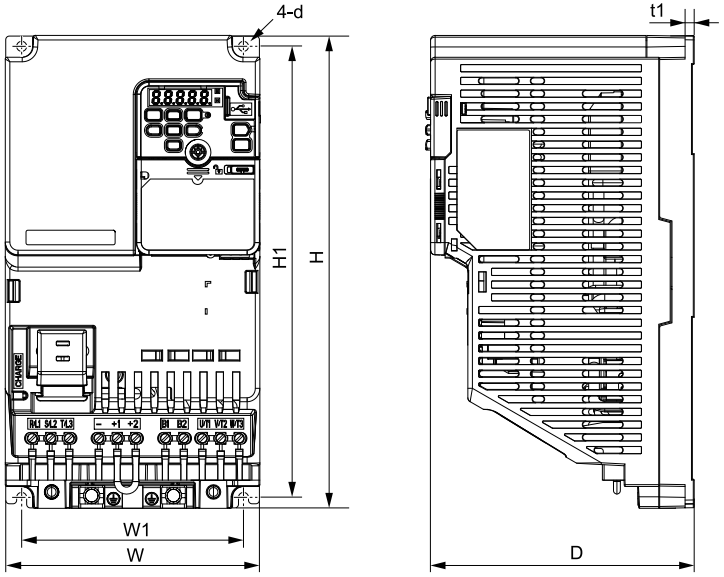


图 7.3 外形图

表 7.6 三相200 V级（无散热片型）

型号	尺寸 mm (in)							毛重 kg (lb)
	W	H	D	W1	H1	t1	d	
2030	140 (5.51)	260 (10.24)	145 (5.71)	122 (4.80)	248 (9.76)	5 (0.20)	M5	2.9 (6.39)
2042	140 (5.51)	260 (10.24)	145 (5.71)	122 (4.80)	248 (9.76)	5 (0.20)	M5	3.1 (6.83)
2056	180 (7.09)	300 (11.81)	147 (5.79)	160 (6.30)	284 (11.18)	5 (0.20)	M5	4.5 (9.92)
2070	220 (8.66)	350 (13.78)	152 (5.98)	192 (7.56)	336 (13.23)	5 (0.20)	M6	6.0 (13.23)

表 7.7 三相400 V级（无散热片型）

型号	尺寸 mm (in)							毛重 kg (lb)
	W	H	D	W1	H1	t1	d	
4018	140 (5.51)	260 (10.24)	145 (5.71)	122 (4.80)	248 (9.76)	5 (0.20)	M5	2.6 (5.73)
4023	140 (5.51)	260 (10.24)	145 (5.71)	122 (4.80)	248 (9.76)	5 (0.20)	M5	2.8 (6.17)
4031	180 (7.09)	300 (11.81)	147 (5.79)	160 (6.30)	284 (11.18)	5 (0.20)	M5	4.1 (9.04)
4038	180 (7.09)	300 (11.81)	147 (5.79)	160 (6.30)	284 (11.18)	5 (0.20)	M5	4.3 (9.48)

8 外部散热体的选择

以下对外部散热器的选型方法进行说明。

◆ 选择外部散热器时需要的数据

符号	详细内容
P_{Loss}	变频器散热片固定板的发热量(发生损耗(W)) *1
T_{HSP_max}	变频器散热片固定板的温度上限 散热片固定板的温度上限。可以通过参数U4-08［散热片温度］监视。温 度上限因变频器机型而异。 • B001～B012：90 °C（194 °F） • 2001～2021：90 °C（194 °F） • 2030～2070：80 °C（176 °F） • 4001～4012：90 °C（194 °F） • 4018～4038：80 °C（176 °F）
T_{Amb}	外部散热器环境温度
$R\theta_{HSP}$	变频器散热片固定板的热阻 此值为0.05 K/W。

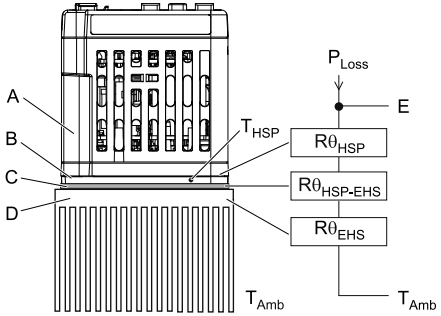
符号	详细内容	
$R\theta_{HSP-EHS}$	变频器的散热片固定板和外部散热器之间的热阻可通过下式算出。 $R\theta_{HSP-EHS} = \frac{d_{Comp}}{\lambda_{Comp} \cdot A_{th}}$	
	A_{th}	变频器散热片固定板和外部散热器间的导热面积 （注） 散热片固定板表面的发热状况会因电子元件的排列而异。计算热阻时，请将有效的导热面积设定为散热片固定板面积的70%。 散热片固定板的面积请通过外形尺寸 *2中的H和W算出。
	λ_{Comp}	导热硅脂的热传导率
	d_{Comp}	导热硅脂的涂层厚度
$R\theta_{EHS}$	外部散热器热阻	

*1 「变频器的发热量」（13 页）请参照。
*2 「变频器外形图」（22 页）请参照。

◆ 外部散热器的选择方法

请确保散热片固定板的温度不会受环境温度影响而超过上限。请选择适当的外部散热器。

热量从散热片固定板向外部散热器周围传导的相关要素如图 8.1所示。



A - 变频器
B - 散热片固定板
C - 导热硅脂
D - 外部散热器
E - 散热片固定板温度

图 8.1 热传导要素相关图

■ 根据热阻选择外部散热器

根据下式算出外部散热器的热阻最大值$R\theta_{EHS-max}$。

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

请选择热阻值小于$R\theta_{EHS\text{-}max}$的外部散热器。

请选配外形尺寸（高 × 宽）和变频器相近的外部散热器。即使外部散热器和变频器外形尺寸相近，但如果热阻过大，请按以下要点重新选配。

- 散热片较多
- 散热片较长

请根据变频器的安装环境对外部散热器的热阻$R\theta_{EHS}$进行修正。此外还应考虑到外部散热器因附着脏污或灰尘而导致散热能力降低。

（注） 在以下情况下，需要对外部散热器规格表中标示的热阻进行修正。详细内容请向外部散热器生产厂家咨询。
- 外部散热器的面积比变频器的散热片固定板面积大很多的情况
- 在1个外部散热器上设置2台以上的变频器的情况

■ 判断可否使用所选的外部散热器

根据安装空间等条件选择外部散热器时，请根据下式计算散热片固定板的温度后判断是否可以采用。

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

如果T_{HSP}值低于散热片固定板的温度上限，则代表所选的外部散热器合适。

散热片固定板的温度的确认方法请参照「确认散热片固定板温度」（10 页）。

◆ 外部散热器的选型示例

C6-01 = 1［ND/HD选择 = 可变转矩用途用轻载额定(ND)］时，型号为2006的变频器的外部散热器的选型方法如下例所示。

以下以水谷电机工业（株）制造的外部散热器为例说明计算方法。

- 万能型散热器EF型　EF（98）L：150（热阻$R\theta_{EHS}$ ＝ 1.6 K/W）
- 万能型散热器EF型　EK（95）L：150（热阻$R\theta_{EHS}$ ＝ 1.1 K/W）

表 8.1 外部散热器的选择

符号	值
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

符号	值	
$R\theta_{HSP-EHS}$	A_{th}	H = 128 mm D = 68 mm $A_{th} = 0.7 \times 0.128\ m \times 0.068\ m = 6.1 \times 10^{-3}\ m^2$
	λ_{Comp}	2.0 W/(m·K) 信越化学工业（株）硅油导热硅脂X-23-7795的热传导率
	d_{Comp}	100 μm 导热硅脂的推荐涂抹量（涂层厚度）
	$R\theta_{HSP_EHS} = \frac{100\ \mu m}{2.0\ W/(m\cdot K) \times 6.1 \times 10^{-3}\ m^2} = 0.008\ K/W$	

■ 根据热阻选择外部散热器

将表 8.1的值代入「根据热阻选择外部散热器」（27 页）的计算式。

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

因为散热器EF(98) L:150的热阻为1.6K/W，所以可以使用。但是，为了防止因一时的温度上升，或因脏污、灰尘附着导致外部散热器的散热能力下降等环境变化导致出现过热故障，推荐使用散热器EK(95)L:150。

■ 判断可否使用所选的外部散热器

因为散热器EF(98) L:150的热阻为1.6K/W，因此散热片固定板的温度可通过下式算出。

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

因为未达到散热片固定板的90 °C温度上限，所以可以使用。但是，考虑到传热面积仅为变频器安装面积的70%左右，以及因脏污、灰尘附着导致外部散热器的散热能力下降等变化的环境因素，推荐使用$R\theta_{EHS}$=1.1K/W(T_{HSP} ＝ 68.95 °C)的散热器EK(95)L:150。

9 支持UL标准所需的使用条件(Conditions of Acceptability)

为了使使用本产品的机械及装置支持UL标准，需满足以下条件。

有关其它满足UL标准的条件，请参阅产品随附使用说明书。

1. 无散热片型变频器请安装在不小于表 9.1所示容积且带有换气功能的控制柜内。

表 9.1 控制柜最小容积

型号	最小容积 cm^3 (in^3)
B001～B006 2001～2012	9850 (600)
B010～B012 2018～2042 4001～4023	15750 (960)
2056～2070 4031，4038	42000 (2560)

2. 环境温度不得超过35 °C (95 °F)。
3. 变频器散热片固定板温度不得超过表 9.2所示的上限温度。
   变频器的散热片温度可以通过U4-08［散热片温度］查看。

表 9.2 散热片固定板的温度上限

型号	温度上限
B001～B012	90 °C (194 °F)
2001～2021	90 °C (194 °F)
2030～2070	80 °C (176 °F)
4001～4012	90 °C (194 °F)
4018～4038	80 °C (176 °F)

4. 安装变频器的金属壁面需满足以下条件。
   - 平整度：0.2 mm (0.0078 in)以下
   - 表面粗糙度：25 S以下
5. 请确保变频器散热所需的通风空间以及接线用空间。
   - 左右：30 mm (1.18 in)以上
   - 上下：100 mm (3.94 in)以上
6. 导热硅脂推荐使用信越化学工业(株)制X-23-7795。请在散热片固定板的导热硅脂涂抹面全部涂抹厚度100 μm～250 μm的涂层。
7. 请使用规定的螺丝将变频器安装在金属壁面（控制柜）。螺丝尺寸和紧固力矩的详情请参照表 9.3。
   在外部散热器和变频器的衔接处的顶部中间，测量外部散热器的温度，以确认散热效果是否充分。

表 9.3 安装螺丝尺寸和紧固力矩

变频器型号	螺丝尺寸	紧固力矩 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)
2030～2056	M5	2.0～2.5 (17.7～22.1)
2070	M6	4.0～5.0 (35.4～44.3)
4001～4012	M5	2.0～2.5 (17.7～22.1)
4018～4038	M5	2.0～2.5 (17.7～22.1)

改版记录

发行年 / 月	改版编号	项目编号	变更点
2021年9月	1	5、7、8	增加:增加了机型及相应信息 • 三相200 V级:CIPR-GA50x2030～2070 • 三相400 V级:CIPR-GA50x4018～4038
		9	增加: 支持UL标准所需的使用条件(Conditions of Acceptability)
2020年12月	-	-	初版发行

安川变频器 GA500

无散热片型

设置要领说明书

客户服务热线(帮您解决技术问题)
电话 **400-821-3680**　传真 **021-5385-2008** 周一至周五(节假日除外)9:00～11:30，12:30～16:30　※24小时接收传真

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YASKAWA Electric Corporation

最终使用者若为军事单位，或将本产品用于兵器制造等用途时，本产品将成为《外汇及外国贸易法》规定的出口产品管制对象，在出口时，需进行严格检查，并办理所需的出口手续。

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中英併記用裏表紙（140×182）　新ロゴ

YASKAWA AC Drive GA500

Finless-Type Drive

Installation Manual

安川变频器GA500

无散热片型

设置要领说明书

Any inquiries related to the product can be directed to the address listed at the end of each section in the related language.

有关本产品的联系方式，请参照各语言版本的最后一页。

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In the event that the end user of this product is to be the military and said product is to be employed in any weapons systems or the manufacture thereof, the export will fall under the relevant regulations as stipulated in the Foreign Exchange and Foreign Trade Regulations. Therefore, be sure to follow all procedures and submit all relevant documentation according to any and all rules, regulations and laws that may apply.

Specifications are subject to change without notice for ongoing product modifications and improvements.

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