

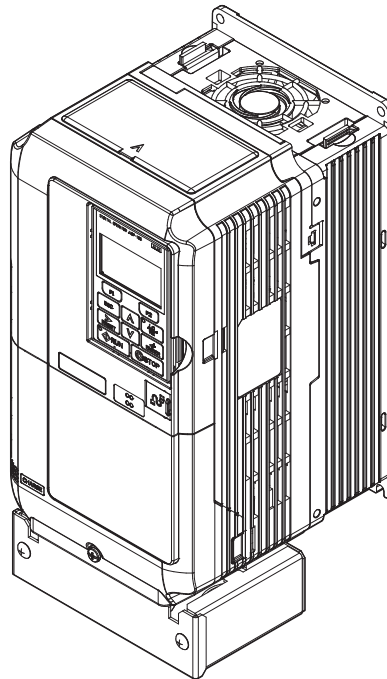
YASKAWA AC Drive-A1000

High Performance Vector Control Drive

Technical Manual

Type: CIMR-AU□A□□

Models: 200 V Class: 0.4 to 110 kW (3/4 to 175 HP ND)
400 V Class: 0.4 to 630 kW (3/4 to 1000 HP ND)
600 V Class: 0.75 to 185 kW (1 to 250 HP ND)



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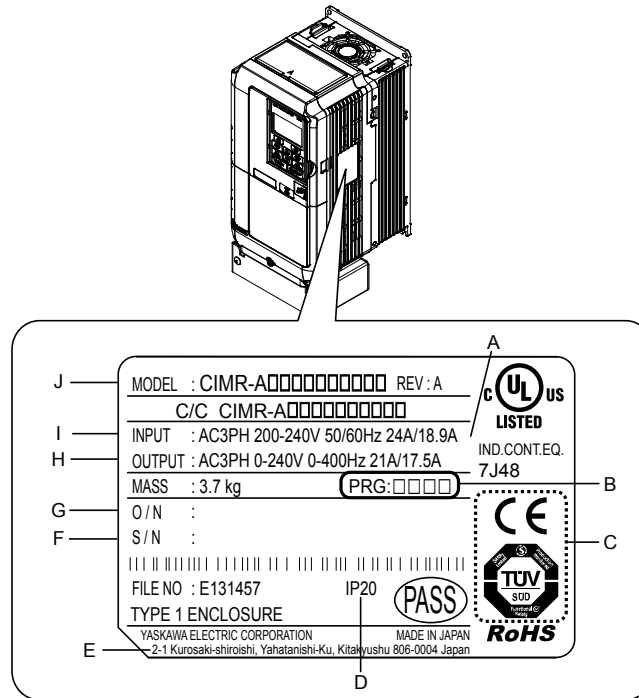
Quick Reference Sheet **E**

1.3 Model Number and Nameplate Check

Please perform the following tasks after receiving the drive:

- Inspect the drive for damage.
- If the drive appears damaged upon receipt, contact the shipper immediately.
- Verify receipt of the correct model by checking the information on the nameplate.
- If you have received the wrong model or the drive does not function properly, contact Yaskawa or a Yaskawa representative.

◆ Nameplate



A – Normal Duty Amps / Heavy Duty Amps

B – Software version

C – CE and TÜV Certification <1>

D – Enclosure type

E – Address <2>

F – Serial number

G – Lot number

H – Output specifications

I – Input specifications

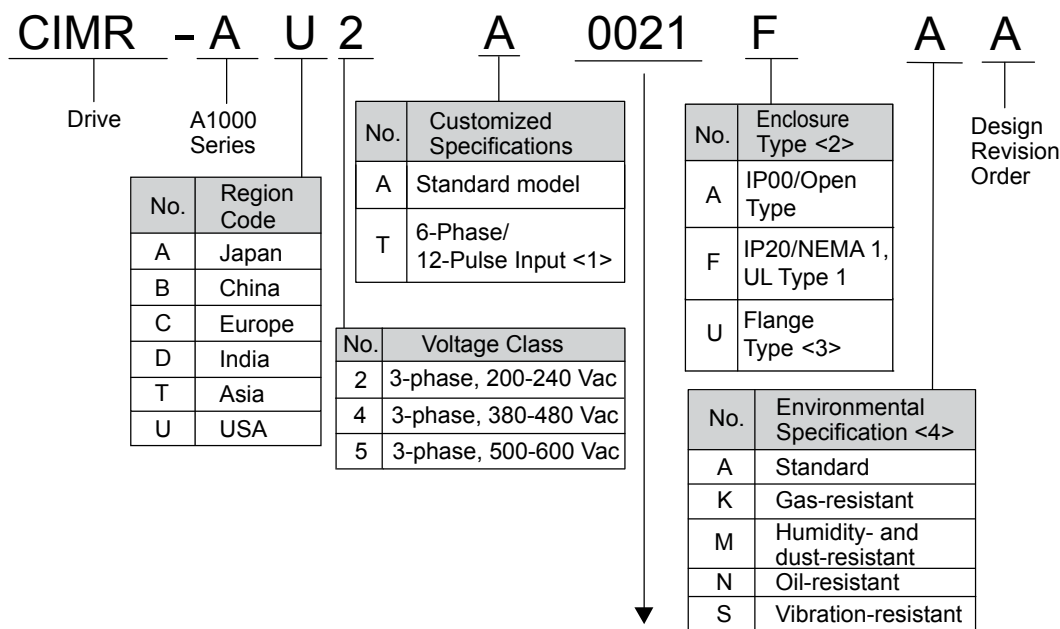
J – AC drive model

Figure 1.1 Nameplate Information Example

<1> Certification is model-dependent. [Refer to UL and CSA Standards on page 748](#) for details.

<2> The address of the head office of Yaskawa Electric Corporation (responsible for product liability) is shown on the nameplate.

1.3 Model Number and Nameplate Check



<1> Refer to manual TOEP C710616 50 for information on 12-pulse models.

<2> [Refer to Drive Models and Enclosure Types on page 39](#) for differences regarding enclosure protection types and component descriptions.

<3> Provides method of mounting drive with backside (heatsink) external to enclosure, with NEMA 12, UL Type 12 integrity.

<4> Drives with these specifications do not guarantee complete protection for the environmental conditions indicated.

■ Three-Phase 200 V

Table 1.3 Model Number and Specifications (200 V)

Normal Duty (ND) C6-01 = 1			Heavy Duty (HD) C6-01 = 0		
Drive Model	Max. Motor Capacity kW (HP)	Rated Output Current A	Drive Model	Max. Motor Capacity kW (HP)	Rated Output Current A
2A0004	0.75 (0.75)	3.5	2A0004	0.4 (0.75)	3.2
2A0006	1.1 (1)	6.0	2A0006	0.75 (1)	5
2A0008	1.5 (2)	8.0	2A0008	1.1 (2)	6.9
2A0010	2.2 (3)	9.6	2A0010	1.5 (2)	8
2A0012	3.0 (3)	12	2A0012	2.2 (3)	11
2A0018	3.7 (5)	17.5	2A0018	3.0 (3)	14.0
2A0021	5.5 (7.5)	21	2A0021	3.7 (5)	17.5
2A0030	7.5 (10)	30	2A0030	5.5 (7.5)	25
2A0040	11 (15)	40	2A0040	7.5 (10)	33
2A0056	15 (20)	56	2A0056	11 (15)	47
2A0069	18.5 (25)	69	2A0069	15 (20)	60
2A0081	22 (30)	81	2A0081	18.5 (25)	75
2A0110	30 (40)	110	2A0110	22 (30)	85
2A0138	37 (50)	138	2A0138	30 (40)	115
2A0169	45 (60)	169	2A0169	37 (50)	145
2A0211	55 (75)	211	2A0211	45 (60)	180
2A0250	75 (100)	250	2A0250	55 (75)	215
2A0312	90 (125)	312	2A0312	75 (100)	283
2A0360	110 (150)	360	2A0360	90 (125)	346
2A0415	110 (175)	415	2A0415	110 (150)	415

Note: [Refer to Drive Models and Enclosure Types on page 39](#) for differences regarding enclosure protection types and descriptions of drive components.

■ Three-Phase 400 V

Table 1.4 Model Number and Specifications (400 V)

Normal Duty (ND) C6-01 = 1			Heavy Duty (HD) C6-01 = 0		
Drive Model	Max. Motor Capacity kW (HP)	Rated Output Current A	Drive Model	Max. Motor Capacity kW (HP)	Rated Output Current A
4A0002	0.75 (0.75)	2.1	4A0002	0.4 (0.75)	1.8
4A0004	1.5 (2)	4.1	4A0004	0.75 (2)	3.4
4A0005	2.2 (3)	5.4	4A0005	1.5 (3)	4.8
4A0007	3.0 (3)	6.9	4A0007	2.2 (3)	5.5
4A0009	3.7 (5)	8.8	4A0009	3.0 (5)	7.2
4A0011	5.5 (7.5)	11.1	4A0011	3.7 (5)	9.2
4A0018	7.5 (10)	17.5	4A0018	5.5 (7.5)	14.8
4A0023	11 (15)	23	4A0023	7.5 (10)	18
4A0031	15 (20)	31	4A0031	11 (15)	24
4A0038	18.5 (25)	38	4A0038	15 (20)	31
4A0044	22 (30)	44	4A0044	18.5 (25-30)	39
4A0058	30 (40)	58	4A0058	22 (25-30)	45
4A0072	37 (50)	72	4A0072	30 (40)	60
4A0088	45 (60)	88	4A0088	37 (50-60)	75
4A0103	55 (75)	103	4A0103	45 (50-60)	91
4A0139	75 (100)	139	4A0139	55 (75)	112
4A0165	90 (125)	165	4A0165	75 (100)	150
4A0208	110 (150)	208	4A0208	90 (125-150)	180
4A0250	132 (200)	250	4A0250	110 (150)	216
4A0296	160 (250)	296	4A0296	132 (200)	260
4A0362	185 (300)	362	4A0362	160 (250)	304
4A0414	220 (350)	414	4A0414	185 (300)	370
4A0515	250 (400-450)	515	4A0515	220 (350)	450
4A0675	355 (500-550)	675	4A0675	315 (400-450-500)	605
4A0930	500 (750)	930	4A0930	450 (650)	810
4A1200	630 (1000)	1200	4A1200	560 (900)	1090

Note: Refer to *Drive Models and Enclosure Types on page 39* for differences regarding enclosure protection types and descriptions of drive components.

■ Three-Phase 600 V

Table 1.5 Model Number and Specifications (600 V)

Normal Duty (ND) C6-01 = 1			Heavy Duty (HD) C6-01 = 0		
Drive Model	Max. Motor Capacity kW (HP)	Rated Output Current A	Drive Model	Max. Motor Capacity kW (HP)	Rated Output Current A
5A0003	1.5 (2)	2.7	5A0003	0.75 (1)	1.7
5A0004	2.2 (3)	3.9	5A0004	1.5 (2)	3.5
5A0006	3.7 (5)	6.1	5A0006	2.2 (3)	4.1
5A0009	5.5 (7.5)	9	5A0009	3.7 (5)	6.3
5A0011	7.5 (10)	11	5A0011	5.5 (7.5)	9.8
5A0017	11 (15)	17	5A0017	7.5 (10)	12.5
5A0022	15 (20)	22	5A0022	11 (15)	17
5A0027	18.5 (25)	27	5A0027	15 (20)	22
5A0032	22 (30)	32	5A0032	18.5 (25)	27
5A0041	30 (40)	41	5A0041	22 (25-30)	32
5A0052	37 (50)	52	5A0052	30 (40)	41

1.3 Model Number and Nameplate Check

Normal Duty (ND) C6-01 = 1			Heavy Duty (HD) C6-01 = 0		
Drive Model	Max. Motor Capacity kW (HP)	Rated Output Current A	Drive Model	Max. Motor Capacity kW (HP)	Rated Output Current A
5A0062	45 (60)	62	5A0062	37 (50-60)	52
5A0077	55 (75)	77	5A0077	45 (50-60)	62
5A0099	75 (100)	99	5A0099	55 (75)	77
5A0125	90 (125)	125	5A0125	75 (100)	99
5A0145	110 (150)	145	5A0145	90 (125)	130
5A0192	160 (200)	192	5A0192	110 (150)	172
5A0242	185 (250)	242	5A0242	160 (200)	200

Note: *Refer to Drive Models and Enclosure Types on page 39* for differences regarding enclosure protection types and descriptions of drive components.

1.4 Drive Models and Enclosure Types

Two types of enclosures are offered for A1000 drives:

- IP20/NEMA 1, UL Type 1 enclosure models mount to an indoor wall or in an enclosure panel.
- IP00/Open Type enclosure models are designed for installation in an enclosure panel that serves to protect personnel from injury caused by accidentally touching live parts.

Table 1.6 describes drive enclosures and models.

Table 1.6 Drive Models and Enclosure Types

Voltage Class	Enclosure Type	
	IP20/NEMA 1, UL Type 1 Enclosure  Drive Model	IP00/Open Type Enclosure Drive Model
Three-Phase 200 V Class	2A0004F	
	2A0006F	
	2A0008F	
	2A0010F	
	2A0012F	
	2A0018F	
	2A0021F	
	2A0030F	
	2A0040F	
	2A0056F	
	2A0069F	
	2A0081F	
	2A0110F	
	2A0138F	
	2A0169F	
	2A0211F	
		2A0250A
		2A0312A
		2A0360A
		2A0415A
Three-Phase 400 V Class	4A0002F	
	4A0004F	
	4A0005F	
	4A0007F	
	4A0009F	
	4A0011F	
	4A0018F	
	4A0023F	
	4A0031F	
	4A0038F	
	4A0044F	
	4A0058F	
	4A0072F	

1.4 Drive Models and Enclosure Types

Voltage Class	Enclosure Type	
	IP20/NEMA 1, UL Type 1 Enclosure ^{<1>} Drive Model	IP00/Open Type Enclosure Drive Model
Three-Phase 400 V Class	4A0088F	<1>
	4A0103F	<1>
	4A0139F	<1>
	4A0165F	<1>
	<2>	4A0208A
	<2>	4A0250A
	<2>	4A0296A
	<2>	4A0362A
	<3>	4A0414A
	<3>	4A0515A
	<3>	4A0675A
	<3>	4A0930A
	<3>	4A1200A
Three-Phase 600 V Class	5A0003F	<1>
	5A0004F	<1>
	5A0006F	<1>
	5A0009F	<1>
	5A0011F	<1>
	5A0017F	<1>
	5A0022F	<1>
	5A0027F	<1>
	5A0032F	<1>
	5A0041F	<1>
	5A0052F	<1>
	5A0062F	<1>
	5A0077F	<1>
	5A0099F	<1>
	<2>	5A0125A
	<2>	5A0145A
	<2>	5A0192A
	<2>	5A0242A

<1> Removing the top protective cover from an IP20/NEMA 1, UL Type 1 enclosure drive voids NEMA 1, UL Type 1 protection while retaining IP20 conformity.

<2> Customers may convert these models to IP20/NEMA 1, UL Type 1 enclosures using an IP20/NEMA 1, UL Type 1 Kit. [Refer to IP20/NEMA 1, UL Type 1 Kit Selection on page 70](#) to select the appropriate kit.

<3> Contact a Yaskawa representative for IP20/NEMA 1, UL Type 1 Kit availability for these models.

A.3 Drive Specifications

- Note:**
1. Perform rotational Auto-Tuning to obtain the performance specifications given below.
 2. For optimum performance life of the drive, install the drive in an environment that meets the required specifications.

Item		Specification
Control Characteristics	Control Method	The following control methods can be set using drive parameters: • V/f Control (V/f) • V/f Control with PG (V/f w/PG) • Open Loop Vector Control (OLV) • Closed Loop Vector Control (CLV) • Open Loop Vector Control for PM (OLV/PM) • Advanced Open Loop Vector Control for PM (AOLV/PM) • Closed Loop Vector Control for PM (CLV/PM)
	Frequency Control Range	0.01 to 400 Hz
	Frequency Accuracy (Temperature Fluctuation)	Digital input: within $\pm 0.01\%$ of the max output frequency (-10 to $+40$ °C) Analog input: within $\pm 0.1\%$ of the max output frequency (25 °C ± 10 °C)
	Frequency Setting Resolution	Digital inputs: 0.01 Hz Analog inputs: 1/2048 of the maximum output frequency setting (11 bit plus sign)
	Output Frequency Resolution	0.001 Hz
	Frequency Setting Signal	Main speed frequency reference: DC -10 to $+10$ V (20 k Ω), DC 0 to $+10$ V (20 k Ω), 4 to 20 mA (250 Ω), 0 to 20 mA (250 Ω) Main speed reference: Pulse train input (max. 32 kHz)
	Starting Torque	V/f, V/f w/PG: 150% at 3 Hz OLV: 200% at 0.3 Hz $\angle \angle$ CLV, AOLV/PM, CLV/PM: 200% at 0.0 r/min $\angle \angle$ OLV/PM: 100% at 3 Hz
	Speed Control Range	V/f, V/f w/PG: 1:40 OLV: 1:200 CLV, CLV/PM: 1:1500 OLV/PM: 1:20 AOLV/PM: 1:100 $\angle \angle \angle \angle$
	Speed Control Accuracy	OLV: $\pm 0.2\%$ (25 °C ± 10 °C) CLV: $\pm 0.02\%$ (25 °C ± 10 °C) $\angle \angle$
	Speed Response	OLV, OLV/PM, AOLV/PM: 10 Hz (25 °C ± 10 °C (77 °F ± 50 °F)) CLV, CLV/PM: 50 Hz (25 °C ± 10 °C (77 °F ± 50 °F))
	Torque Limit	Parameter settings allow separate limits in four quadrants (OLV, CLV, AOLV/PM, CLV/PM)
	Accel/Decel Time	0.0 to 6000.0 s (4 selectable combinations of independent acceleration and deceleration settings)
	Braking Torque	Approx. 20% (approx. 125% when using braking resistor) $\angle \angle$ • Short-time decel torque $\angle \angle$: over 100% for 0.4/ 0.75 kW motors, over 50% for 1.5 kW motors, and over 20% for 2.2 kW and above motors $\angle \angle$ (overexcitation/High Slip Braking: approx. 40%) • Continuous regenerative torque: approx. 20% $\angle \angle$ (approx. 125% with dynamic braking resistor option $\angle \angle$: 10% ED, 10s)
	Braking Transistor	Models 2A0004 to 2A0138, 4A0002 to 4A0072, and 5A0003 to 5A0052 have a built-in braking transistor.
	V/f Characteristics	User-selected programs and V/f preset patterns possible
	Main Control Functions	Torque Control, Droop Control, Speed/torque Control Switching, Feed Forward Control, Zero Servo Function, Momentary Power Loss Ride-Thru, Speed Search, Overtorque/Undertorque Detection, Torque Limit, 17 Step Speed (max), Accel/decel Switch, S-curve Accel/decel, 3-wire Sequence, Auto-tuning (rotational, stationary tuning), Dwell, Cooling Fan on/off Switch, Slip Compensation, Torque Compensation, Frequency Jump, Upper/lower Limits for Frequency Reference, DC Injection Braking at Start and Stop, Overexcitation Braking, High Slip Braking, PID Control (with sleep function), Energy Saving Control, MEMOBUS/Modbus Comm. (RS-422/RS-485 max, 115.2 kbps), Fault Restart, Application Presets, DriveWorksEZ (customized function), Removable Terminal Block with Parameter Backup Function, Online Tuning, KEB, Overexcitation Deceleration, Inertia (ASR) Tuning, Overvoltage Suppression, High Frequency Injection.

Item		Specification
Protection Functions	Motor Protection	Electronic thermal overload relay
	Momentary Overcurrent Protection	Drive stops when output current exceeds 200% of Heavy Duty Rating
	Overload Protection	Drive stops after 60 s at 150% of rated Heavy Duty output current ^{<9>}
	Overvoltage Protection	200 V class: Stops when DC bus voltage exceeds approx. 410 V 400 V class: Stops when DC bus voltage exceeds approx. 820 V 600 V class: Stops when DC bus voltage exceeds approx. 1040 V
	Undervoltage Protection	200 V class: Stops when DC bus voltage falls below approx. 190 V 400 V class: Stops when DC bus voltage falls below approx. 380 V 600 V class: Stops when DC bus voltage falls below approx. 475 V
	Momentary Power Loss Ride-Thru	Immediately stop after 15 ms or longer power loss. ^{<10>} Continuous operation during power loss than 2 s (standard) ^{<11>}
	Heatsink Overheat Protection	Thermistor
	Braking Resistor Overheat Protection	Overheat input signal for braking resistor (Optional ERF-type, 3% ED)
	Stall Prevention	Stall Prevention is available during acceleration, deceleration, and during run.
	Ground Protection	Electronic circuit protection ^{<12>}
	DC Bus Charge LED	Remains lit until DC bus voltage falls below 50 V
Environment	Area of Use	Indoors
	Ambient Temperature	IP20/NEMA 1, UL Type 1 enclosure: -10 °C to +40 °C (14 °F to 104 °F) IP00 enclosure: -10 °C to +50 °C (14 °F to 122 °F) Finless Type: IP20/IP00 enclosure: -10 °C to +45 °C (14 °F to 113 °F)
	Humidity	95 RH% or less (no condensation)
	Storage Temperature	-20 °C to +60 °C (-4 °F to +140 °F) short-term temperature during transportation
	Altitude	Up to 1000 meters without derating, up to 3000 m with output current and voltage derating. <i>Refer to Altitude Derating on page 554</i> for details.
	Vibration/Shock	10 to 20 Hz: 9.8 m/s ² ^{<13>} 20 to 55 Hz: 5.9 m/s ² (2A0004 to 2A0211, 4A0002 to 4A0165, and 5A0003 to 5A0099) 2.0 m/s ² (2A0250 to 2A0415, 4A0208 to 4A1200, and 5A0125 to 5A0242)
Standard		- UL508C - IEC/EN 61800-3, IEC/EN 61800-5-1 - Two Safe Disable inputs and one EDM output according to ISO/EN 13849-1 Cat. 3 PLd, IEC/EN 61508 SIL2 - CSA
Protection Design		IP00/Open Type enclosure, IP20/NEMA 1, UL Type 1 enclosure ^{<14>}

<1> Select control modes in accordance with drive capacity.

<2> High-frequency current superposition (n8-57=1) is available.

<3> Perform Rotational Auto Tuning.

<4> Contact Yaskawa or your nearest sales representative if using a PM motor other than Super Energy-saving Motors manufactured by Yaskawa Motor Co., Ltd. (SSR1 series and SST4 series with standard specifications).

<5> The accuracy of these values depends on motor characteristics, ambient conditions, and drive settings. Specifications may vary with different motors and with changing motor temperature. Contact Yaskawa for consultation.

<6> Disable Stall Prevention during deceleration (L3-04 = 0) when using a regenerative converter, a regenerative unit, a braking resistor or the Braking Resistor Unit. The default setting for the Stall Prevention function will interfere with the braking resistor.

<7> Instantaneous average deceleration torque refers to the torque required to decelerate the motor (uncoupled from the load) from the rated motor speed down to zero in the shortest time.

<8> Actual specifications may vary depending on motor characteristics.

<9> Overload protection may be triggered when operating with 150% of the rated output current if the output frequency is less than 6 Hz.

<10> May be shorter due to load conditions and motor speed.

<11> A separate Momentary Power Loss Ride-Thru Unit is required for models 2A0004 to 2A0056 and 4A0002 to 4A0031 if the application needs to continue running for up to 2 seconds during a momentary power loss.

<12> Ground protection is triggered when a ground short circuit occurs while the drive is running. The ground protection cannot be provided when the impedance of the ground fault path is too low, or when the drive is powered up while a ground fault is present at the output.

<13> Models 4A0930 and 4A1200 are rated at 5.9 m/s².

<14> Removing the top protective cover or bottom conduit bracket from an IP20/NEMA 1, UL Type 1 enclosure drive voids NEMA 1, UL Type 1 protection while maintaining IP20 conformity. This is applicable to models 2A0004 to 2A0211, 4A0002 to 4A0165, and 5A0003 to 5A0242.

A.4 Drive Watt Loss Data

Table A.11 Watt Loss 200 V Class Three-Phase Models

Drive Model	Normal Duty				Heavy Duty			
	Rated Amps (A) <3>	Heatsink Loss (W)	Interior Unit Loss (W)	Total Loss (W)	Rated Amps (A)	Heatsink Loss (W)	Interior Unit Loss (W)	Total Loss (W)
2A0004	3.5	18.4	47	66	3.2 <1>	14.8	44	59
2A0006	6.0	31	51	82	5.0 <1>	24	48	72
2A0008	8.0	43	52	95	6.9 <1>	35	49	84
2A0010	9.6	57	58	115	8.0 <1>	43	52	95
2A0012	12.0	77	64	141	11.0 <1>	64	58	122
2A0018	17.5	101	67	168	14.0 <1>	77	60	137
2A0021	21	138	83	222	17.5 <1>	101	67	168
2A0030	30	262	117	379	25 <1>	194	92	287
2A0040	40	293	145	437	33 <1>	214	105	319
2A0056	56	371	175	546	47 <1>	280	130	410
2A0069	69	491	205	696	60 <1>	395	163	558
2A0081	81	527	257	785	75 <1>	460	221	681
2A0110	110	719	286	1005	85 <1>	510	211	721
2A0138	138	842	312	1154	115 <1>	662	250	912
2A0169	169	1014	380	1394	145 <1>	816	306	1122
2A0211	211	1218	473	1691	180 <2>	976	378	1354
2A0250	250	1764	594	2358	215 <2>	1514	466	1980
2A0312	312	2020	665	2686	283 <2>	1936	588	2524
2A0360	360	2698	894	3591	346 <2>	2564	783	3347
2A0415	415	2672	954	3626	415 <3>	2672	954	3626

<1> Value assumes the carrier frequency is set to 8 kHz or less.

<2> Value assumes the carrier frequency is set to 5 kHz or less.

<3> Value assumes the carrier frequency is set to 2 kHz.

Table A.12 Watt Loss 400 V Class Three-Phase Models

Drive Model	Normal Duty				Heavy Duty			
	Rated Amps (A) <3>	Heatsink Loss (W)	Interior Unit Loss (W)	Total Loss (W)	Rated Amps (A)	Heatsink Loss (W)	Interior Unit Loss (W)	Total Loss (W)
4A0002	2.1	20	48	68	1.8 <1>	15.9	45	61
4A0004	4.1	32	49	81	3.4 <1>	25	46	70
4A0005	5.4	45	53	97	4.8 <1>	37	49	87
4A0007	6.9	62	59	121	5.5 <1>	48	53	101
4A0009	8.8	66	60	126	7.2 <1>	53	55	108
4A0011	11.1	89	73	162	9.2 <1>	69	61	130
4A0018	17.5	177	108	285	14.8 <1>	135	86	221
4A0023	23	216	138	354	18.0 <1>	150	97	247
4A0031	31	295	161	455	24 <1>	208	115	323
4A0038	38	340	182	521	31 <1>	263	141	403
4A0044	44	390	209	599	39 <1>	330	179	509
4A0058	58	471	215	686	45 <1>	349	170	518
4A0072	72	605	265	870	60 <1>	484	217	701