HARMONIC DRIVE SYSTEMS INC

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# ENGINEERING SPECIFICATION

## Specifications of the flat and hollow shaft servo-motor

MAC08*200, MAB09*200, MAB09*100

MAB12*200, MAB15*200, MAA21A*200

| APPD | CHKD | BY |
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| | | CLASS | SPEC No. |
|---|---|---|---|
| | | | B0C0366 |
| REV | DESCRIPTION | SHEET No. 1 | OF 8 |

## 1. Application

This specification applies to the following flat and hollow shaft servo motor.

① MAC08A200 (for the Actuator of SHA20A , AC 200V , without brake)
② MAC08B200 (for the Actuator of SHA20A , AC 200V , with brake)
③ MAB09A200 (for the Actuator of SHA25A , AC 200V , without brake)
④ MAB09B200 (for the Actuator of SHA25A , AC 200V , with brake)
⑤ MAB09A100 (for the Actuator of SHA25A , AC 100V , without brake)
⑥ MAB09B100 (for the Actuator of SHA25A , AC 100V , with brake)
⑦ MAB12A200 (for the Actuator of SHA32A , AC 200V , without brake)
⑧ MAB12B200 (for the Actuator of SHA32A , AC 200V , with brake)
⑨ MAB15A200 (for the Actuator of SHA40A , AC 200V , without brake)
⑩ MAB15B200 (for the Actuator of SHA40A , AC 200V , with brake)
⑪ MAA21AA200 (for the Actuator of SHA58A , AC 200V , without brake)
⑫ MAA21AB200 (for the Actuator of SHA58A , AC 200V , with brake)

## 2. Main Specifications

The main specifications are shown in the table 1 and table 2 .
Please refer to the outline drawing of the motor for the outside dimension and wire connection specification.

Table 1 . Specifications (No.①~⑥)

| Item \ Model | | ①MAC08A200<br>②MAC08B200 | ③MAB09A200<br>④MAB09B200 | ⑤MAB09A100<br>⑥MAB09B100 |
|---|---|---|---|---|
| Type | — | Permanent magnet field type AC servo motor | | |
| Number of poles | — | 10 | 10 | 10 |
| Rated torque Note 1, 2 | Nm | 0.52 | 1.0 | 0.88 |
| Rated rotational speed Note 1, 2 | r/min | 3000 | 3000 | 3000 |
| Rated power Note 1, 2 | W | 163 | 314 | 276 |
| Torque constant Note 1 | Nm/Arms | 0.35 | 0.41 | 0.24 |
| Rated current Note 1, 2 | Arms | 2.1 | 3 | 4.7 |
| Rated stall current Note 2 | A | 2.4 | 3.6 | 6.2 |
| Max. torque Note 1 | Nm | 1.8 | 3 | 3 |
| Max. rotational speed Note 1 | r/min | 6000 | 5600 | 4800 |
| Max. current Note 1 | Arms | 6.5 | 8.9 | 15.4 |
| EMF constant Note 3 | V/(r/min) | 0.037 | 0.043 | 0.025 |
| Phase resistance (at 20℃) | Ω | 1.43 | 1.2 | 0.4 |
| Phase inductance | mH | 2.5 | 3 | 1.0 |
| Moment of Inertia (without brake) | $kg \cdot m^2$ | $0.69 \times 10^{-4}$ | $1.4 \times 10^{-4}$ | $1.4 \times 10^{-4}$ |
| Moment of Inertia (with brake) | $kg \cdot m^2$ | $0.78 \times 10^{-4}$ | $1.8 \times 10^{-4}$ | $1.8 \times 10^{-4}$ |
| Mass (without brake) | kg | 1.1 | 1.5 | 1.5 |
| Mass (with brake) | kg | 1.2 | 1.65 | 1.65 |
| Power Supply Voltage | V | AC200 | AC200 | AC100 |
| Encoder type | — | Absolute encoder | | |
| Single motor revolution Encoder resolution | — | $2^{17}$ (131072) | | |
| Motor multi revolution counter | — | $2^{16}$ ( 65536) | | |
| Motor insulation | — | Insulation resistance : 100MΩ MIN (DC 500V)<br>Dielectric strength : AC1500V/1min Insulation class : A | | |

Note 1) Typical characteristics when combined (driven by ideal sine wave) with our drivers.

Note 2) Value after temperature rise and saturation when it is used with aluminum radiation plate shown below.
MAC08 : 320×320×16[mm] / MAB09 : 350×350×18[mm]

Note 3) Value of phase induced voltage constant multiplied by 3.

Table 2 . Specifications (No.⑦～⑫)

| Item \ Model | | ⑦MAB12A200 ⑧MAB12B200 | ⑨MAB15A200 ⑩MAB15B200 | ⑪MAA21AA200 ⑫MAA21AB200 |
|---|---|---|---|---|
| Type | — | Permanent magnet field type AC servo motor | | |
| Number of poles | — | 10 | 10 | 16 |
| Rated torque Note 1, 2 | Nm | 2.2 | 4.5 (2.5) 4) | 14 |
| Rated rotational speed Note 1, 2 | r/min | 2500 | 2000 | 1500 |
| Rated power Note 1, 2 | W | 576 | 942 (524) 4) | 2200 |
| Torque constant Note 1 | Nm/Arms | 0.44 | 0.54 | 0.72 |
| Rated current Note 1, 2 | Arms | 6 | 10 (6) 4) | 23 |
| Rated stall current Note 2 | A | 8.5 | 13 (8.5) 4) | 33 |
| Max. torque Note 1 | Nm | 7 | 13 (8.3) 4) | 45 (33) 5) |
| Max. rotational speed Note 1 | r/min | 4800 | 4000 | 3000 |
| Max. current Note 1 | Arms | 19 | 29 (19) 4) | 75 (55) 5) |
| EMF constant Note 3 | V/(r/min) | 0.046 | 0.057 | 0.075 |
| Phase resistance (at 20℃) | Ω | 0.33 | 0.19 | 0.028 |
| Phase inductance | mH | 1.4 | 1.2 | 0.29 |
| Moment of Inertia (without brake) | $kg \cdot m^2$ | $4.8 \times 10^{-4}$ | $13 \times 10^{-4}$ | $115 \times 10^{-4}$ |
| Moment of Inertia (with brake) | $kg \cdot m^2$ | $6.0 \times 10^{-4}$ | $17 \times 10^{-4}$ | $131 \times 10^{-4}$ |
| Mass (without brake) | kg | 2.8 | 4.4 | 14.8 |
| Mass (with brake) | kg | 3.2 | 5.2 | 17.1 |
| Power Supply Voltage | V | AC200 | AC200 | AC200 |
| Encoder type | — | Absolute encoder | | |
| Single motor revolution Encoder resolution | — | $2^{17}$ (131072) | | |
| Motor multi revolution counter | — | $2^{16}$ ( 65536) | | |
| Motor insulation | — | Insulation resistance : 100MΩ MIN (DC 500V) Dielectric strength : AC1500V/1min Insulation class : A | | |

Note 1) Typical characteristics when combined (driven by ideal sine wave) with our drivers.

Note 2) Value after temperature rise and saturation when it is used with aluminum radiation plate shown below.

MAB12 : 400×400×20[mm]

MAB15 : 500×500×25[mm]

MAA21A : 650×650×30[mm]

Note 3) Value of phase induced voltage constant multiplied by 3.

Note 4) When combined with our drivers (HA-800-6)

Note 5) When combined with our drivers (HA-800-24)

## 3. Operable Range

Fig.1 shows the range which can operate a motor.

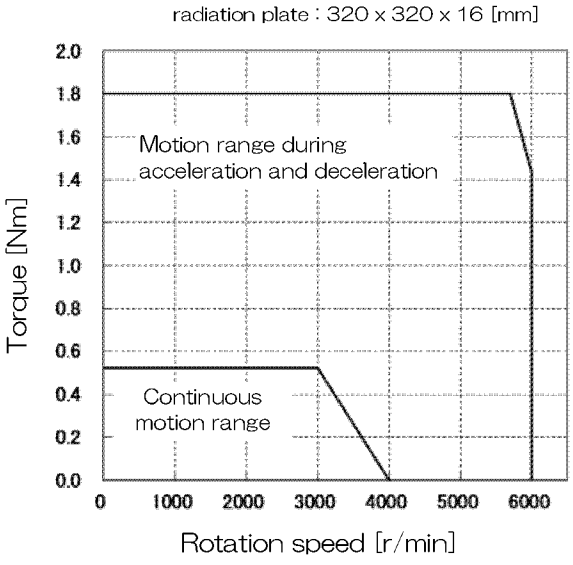


Fig.1-1 ①,② MAC08*200

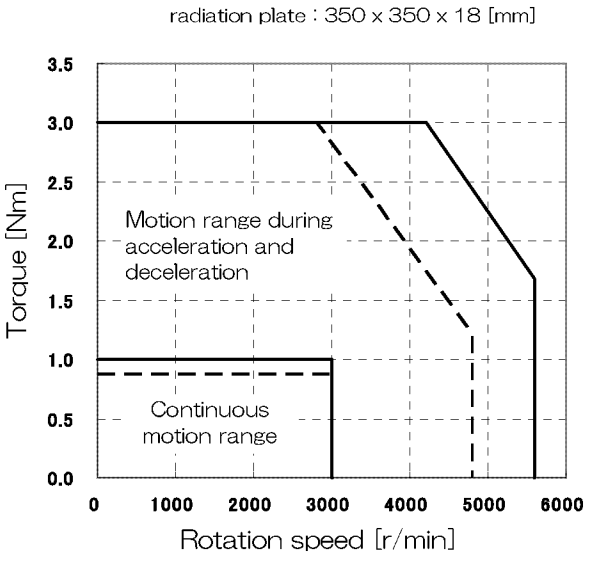


Fig.1-2 ③,④ MAB09*200 (Solid line)
⑤,⑥ MAB09*100 (Dashed line)

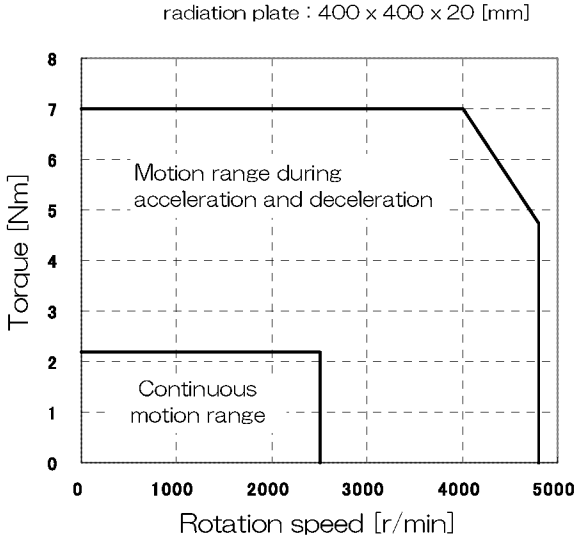


Fig.1-3 ⑦,⑧MAB12*200

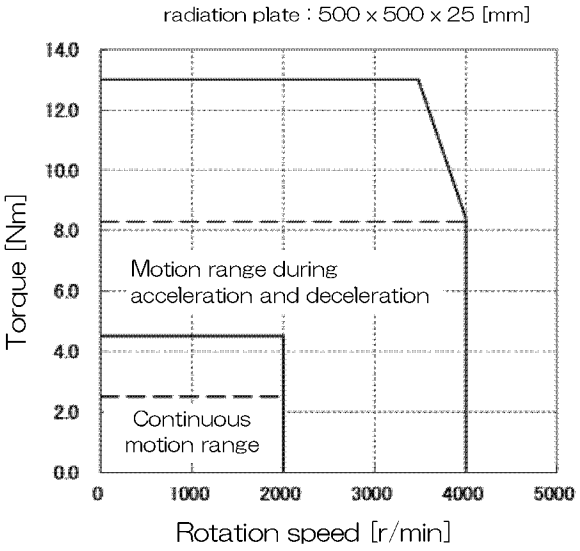


Fig.1-4 ⑨,⑩ MAB15*200

Dashed line : When combined with HA-800-6

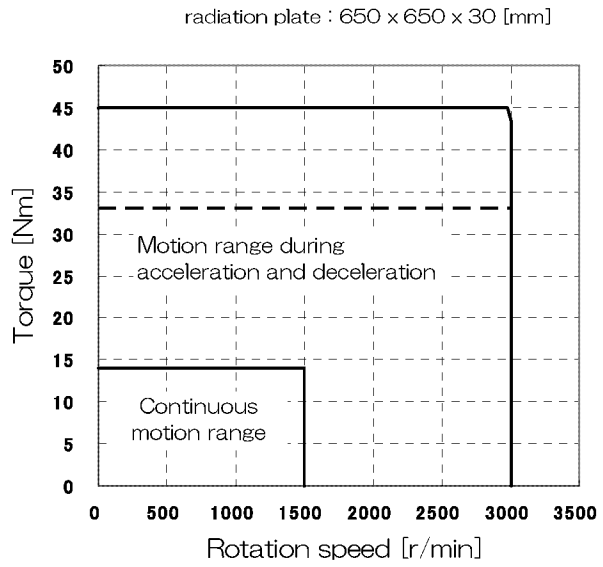


Fig.1-5 ⑪,⑫ MAA21A*200
Dashed line : When combined with HA-800-24

## 4. Motor shaft holding brake

Brake specifications are shown in the table 3 and table 4 .

Table 3 . Specifications (No.② , ⑩ , ⑫)

| Item \ Model | | ②MAC08B200 | ⑩MAB15B200 | ⑫MAA21AB200 |
|---|---|---|---|---|
| Type (without power-saving control) | — | Dry non-excitation actuation type | | |
| Brake excitation voltage | V | DC24V±10% (no polarity) | | |
| Current consumption during suction [1] | A | 0.37 | 0.7 | 0.9 |
| Current consumption during holding [1] | A | 0.37 | 0.7 | 0.9 |
| Holding torque | Nm | 0.6 | 4 | 15 |
| Insulation class | — | F | | |
| Dielectric strength | — | AC500V/1min | | |
| Insulation resistance | — | 100MΩ MIN ( DC500V ) | | |
| Allowable number of normal brakings [2] | times | 100000 | | |
| Allowable number of emergency stops [3] | times | 200 | | |

Note 1) Value at 20℃.

Note 2) The service time for normal holding is assured when the brake activates at motor shaft rotation speed of 150r/min or less.

Note 3) The service time for emergency stop is assured when the brake activates at motor speed of 3000 r/min or less provided the load inertia moment is 3 times of less than that of the motor.

Table 4 . Specifications (No.④ , ⑥ , ⑧)

| Item \ Model | | ④MAB09B200 | ⑥MAB09B100 | ⑧MAB12B200 |
|---|---|---|---|---|
| Type (with power-saving control) | — | Dry non-excitation actuation type | | |
| Brake excitation voltage (no polarity) | V | DC24V±10% | | |
| Current consumption during suction [1, 2] | A | 0.8 | | |
| Current consumption during holding [1] | A | 0.3 | | |
| Holding torque | Nm | 1 | 1 | 2 |
| Insulation class | — | B | | |
| Dielectric strength | — | AC500V/1min | | |
| Insulation resistance | — | 100MΩ MIN ( DC500V ) | | |
| Allowable number of normal brakings [3] | times | 100000 | | |
| Allowable number of emergency stops [4] | times | 200 | | |

Note 1) Value at 20℃.

Note 2) The duration for current consumption during suction is 0.5 second or less for the power supply of DC24V±10%.

Note 3) The service time for normal holding is assured when the brake activates at motor shaft rotation speed of 150r/min or less.

Note 4) The service time for emergency stop is assured when the brake activates at motor speed of 3000 r/min or less provided the load inertia moment is 3 times of less than that of the motor.

## 5. Encoder

This encoder is absolute encoder which has 17bit single turn resolution and 16bit multi turn counts with external back-up battery.

Please refer to separate specification sheet for further information of encoder.

Fig.2 shows relationship between motor's EMF waveform and one rotation absolute data.

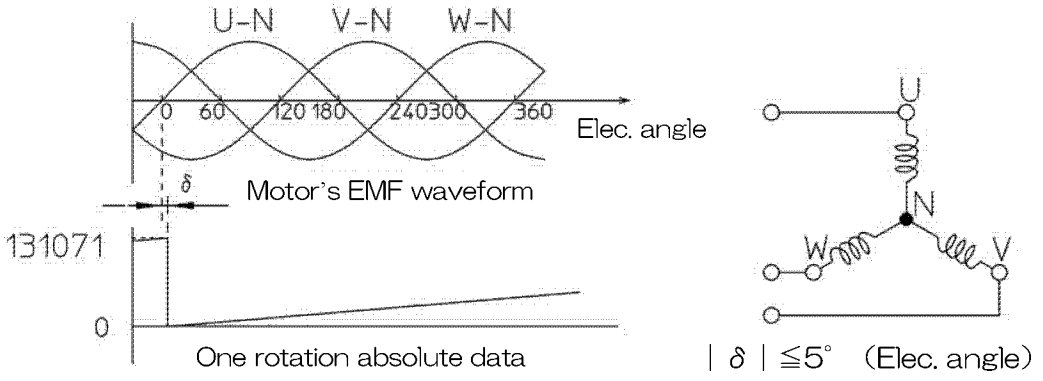


fig 2 (CCW rotation facing the output side)

## 6. Allowable load

Table 5 . Specifications (No.①～⑥)

| Item \ Model | | ①MAC08A200<br>②MAC08B200 | ③MAB09A200<br>④MAB09B200 | ⑤MAB09A100<br>⑥MAB09B100 |
|---|---|---|---|---|
| Allowable radial load [2] | N | 800 | 800 | |
| Allowable axial load [2] | N | 1900 | 2400 | |
| Rated radial load [3] | N | 165 | 180 | |
| Rated axial load [3] | N | 90 | 110 | |

Table 6 . Specifications (No.⑦～⑫)

| Item \ Model | | ⑦MAB12A200<br>⑧MAB12B200 | ⑨MAB15A200<br>⑩MAB15B200 | ⑪MAA21AA200<br>⑫MAA21AB200 |
|---|---|---|---|---|
| Allowable radial load [2] | N | 1200 | 2400 | 4500 |
| Allowable axial load [2] | N | 3600 | 5000 | 14000 |
| Rated radial load [3] | N | 220 | 520 | 700 |
| Rated axial load [3] | N | 135 | 190 | 670 |

Note 1) This table shows values when unidirectional load either radial load or axial load is applied to following point on the output shaft.

Radial load

MAC08 , MAB09 , MAB15 , MAA21A : Tip of output-shaft

MAB12 : Position of 14.2 mm from tip of output-shaft

Axial load : Center of output-shaft

Note 2) The value when motor is stopped.

Note 3) The value when motor is rotated with rated speed.

## 7. Environmental conditions

Table 7 . Specifications

| Item | Unit | Value |
|---|---|---|
| Operating temperature | ℃ | 0～40 |
| Storage temperature | ℃ | -20～60 |
| Operating humidity<br>Storage humidity | %RH | 20 to 80<br>(no condensation) |
| Resistance to vibration | $m/s^2$ | 25 max<br>(frequency : 10 to 400 Hz) |
| Shock resistance | $m/s^2$ | 300 max |