



# *αSTEP* AS Series

## Additional Information

Technical Reference .....F-1  
 General Information .....G-1

Introduction

|    |                          | Motor & Driver Packages |     |    |        |     |     |     |     |       |    | 2-Phase Stepping Motors |        | Controllers |         | Low-Speed Synchronous Motors | Accessories                   |
|----|--------------------------|-------------------------|-----|----|--------|-----|-----|-----|-----|-------|----|-------------------------|--------|-------------|---------|------------------------------|-------------------------------|
| AS | Closed Loop <i>αSTEP</i> | AS PLUS                 | ASC | RK | CRK II | CSK | PMC | UMK | CSK | PK/PV | PK | UI2120G                 | EMP401 | EMP402      | SG8030J | SMK                          | Before Using a Stepping Motor |
|    | AC Input                 | AS PLUS                 | ASC | RK | CRK II | CSK | PMC | UMK | CSK | PK/PV | PK | UI2120G                 | EMP401 | EMP402      | SG8030J | SMK                          | Before Using a Stepping Motor |
|    | DC Input                 | AS PLUS                 | ASC | RK | CRK II | CSK | PMC | UMK | CSK | PK/PV | PK | UI2120G                 | EMP401 | EMP402      | SG8030J | SMK                          | Before Using a Stepping Motor |
|    | 5-Phase Microstep        | AS PLUS                 | ASC | RK | CRK II | CSK | PMC | UMK | CSK | PK/PV | PK | UI2120G                 | EMP401 | EMP402      | SG8030J | SMK                          | Before Using a Stepping Motor |
|    | DC Input                 | AS PLUS                 | ASC | RK | CRK II | CSK | PMC | UMK | CSK | PK/PV | PK | UI2120G                 | EMP401 | EMP402      | SG8030J | SMK                          | Before Using a Stepping Motor |
|    | AC Input                 | AS PLUS                 | ASC | RK | CRK II | CSK | PMC | UMK | CSK | PK/PV | PK | UI2120G                 | EMP401 | EMP402      | SG8030J | SMK                          | Before Using a Stepping Motor |
|    | DC Input                 | AS PLUS                 | ASC | RK | CRK II | CSK | PMC | UMK | CSK | PK/PV | PK | UI2120G                 | EMP401 | EMP402      | SG8030J | SMK                          | Before Using a Stepping Motor |
|    | DC Input                 | AS PLUS                 | ASC | RK | CRK II | CSK | PMC | UMK | CSK | PK/PV | PK | UI2120G                 | EMP401 | EMP402      | SG8030J | SMK                          | Before Using a Stepping Motor |
|    | DC Input                 | AS PLUS                 | ASC | RK | CRK II | CSK | PMC | UMK | CSK | PK/PV | PK | UI2120G                 | EMP401 | EMP402      | SG8030J | SMK                          | Before Using a Stepping Motor |
|    | DC Input                 | AS PLUS                 | ASC | RK | CRK II | CSK | PMC | UMK | CSK | PK/PV | PK | UI2120G                 | EMP401 | EMP402      | SG8030J | SMK                          | Before Using a Stepping Motor |

## Closed Loop Stepping Motor and Driver Package

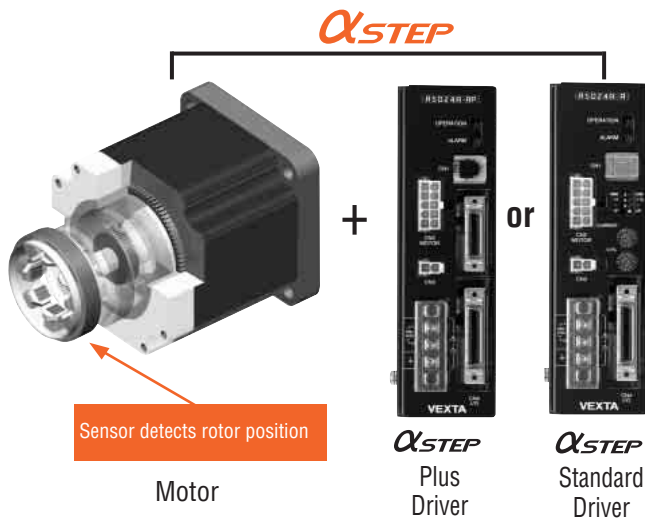
# $\alpha$ STEP AS Series

The  $\alpha$ STEP is a revolutionary hybrid stepping motor and driver package which eliminates missed steps; a common problem with stepping motors. The  $\alpha$ STEP uses a built-in feedback device that constantly monitors the motor shaft position to detect and correct for loss of synchronism. Geared models are also available.

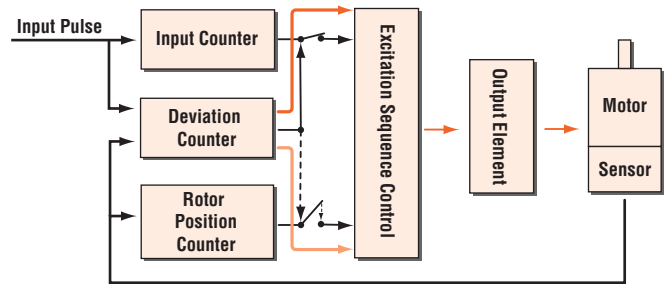
### Features

- Thanks to closed loop control, there is no loss of synchronism.

$\alpha$ STEP does not lose synchronism even when subjected to abrupt load fluctuation or acceleration. A newly developed rotor position detection sensor constantly monitors the motor movement. If synchronism is about to be lost, closed loop control is used, so there is no need to worry about loss of steps.



### $\alpha$ STEP Control Diagram



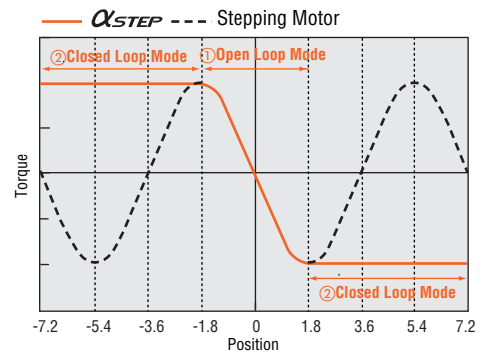
#### Normal (Positioning Deviation is less than $\pm 1.8^\circ$ )

Motor runs in open loop mode like a stepping motor.

#### If Motor Misssteps ( Positioning Deviation is greater than $\pm 1.8^\circ$ )

Control switches to closed loop mode to prevent loss of synchronism.

### $\alpha$ STEP Angle-Torque Characteristics

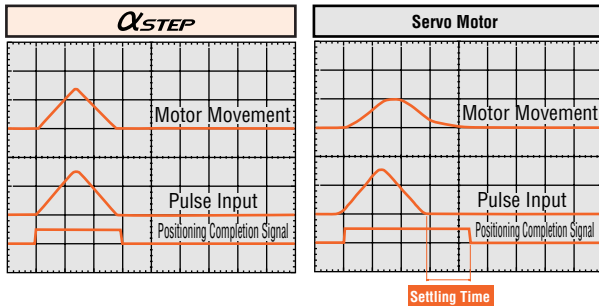


- If the positioning deviation is  $\pm 1.8^\circ$  or smaller, the motor runs in open loop mode like a stepping motor.
- If the positioning deviation is  $\pm 1.8^\circ$  or greater, the motor runs in closed loop mode and the position is corrected by exciting the motor windings to generate maximum torque based on the rotor position.

### ● High Response

Like conventional stepping motors,  $\alpha$ STEP operates in synchronism with command pulses. This makes possible short stroke positioning in a short time.

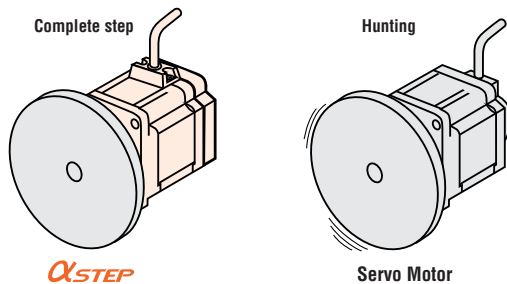
Measurement condition : Feed 1/5 rotation  
Load inertia 1.365 oz-in<sup>2</sup> ( $250 \times 10^{-7}$  kg·m<sup>2</sup>)



- In traditional servo motors, there is a delay between the input pulse signals and the motor movement due to the way positioning is continuously monitored. Therefore, a servo motor needs time to settle to a stop after input signals stop. This is called settling time.

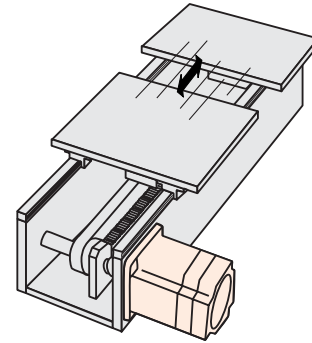
### ● No Hunting

Since  $\alpha$ STEP is a stepping motor, it has no hunting problem such as might be found in a traditional servo motor. Therefore, when it stops, its position is completely stable and does not fluctuate.  $\alpha$ STEP is ideal for applications in which vibration would be a problem.



### ● No Gain Tuning

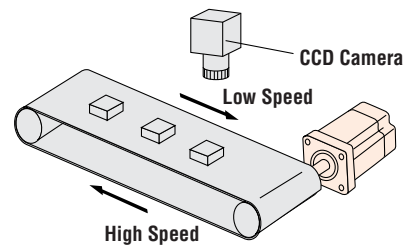
Gain tuning for a servo motor is critical, troublesome and time-consuming. Since the  $\alpha$ STEP operates like a stepping motor, there are no gain tuning requirements. Low rigidity applications, such as a belt and pulley system, are ideal for  $\alpha$ STEP.



### ● Low Vibration at Low Speed

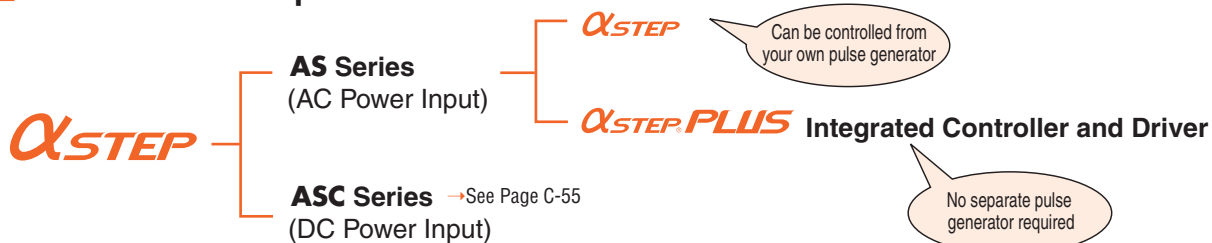
The driver employs advanced technology that produces smoothness comparable to a microstepping driver. Its vibration level is incredibly low, even when operating in the low speed range. When frequent changes from low (high) to high (low) speed operation are required, the use of the Resolution Select Function solves the problem.

$\alpha$ STEP provides resolution as low as 0.036° per step without any damping mechanism or other mechanical device. Even smoother operation is possible with geared models.



$\alpha$ STEP is well suited to applications where smooth movement or stability is required, such as where a camera is used to monitor the quality of a product.

## AS Series Line-Up



### Standard

- Basic Model of **ALPHA STEP** Motor and Driver System



### Tapered Hob (TH) Geared

- A wide variety of low gear ratios for high-speed operation
- Gear Ratios 3.6:1, 7.2:1, 10:1, 20:1, 30:1



### Planetary (PN) Geared

- High speed (low gear ratios), High positioning precision
- High permissible torque
- Centered output shaft
- Gear Ratios 5:1, 7.2:1, 10:1, 25:1, 36:1, 50:1



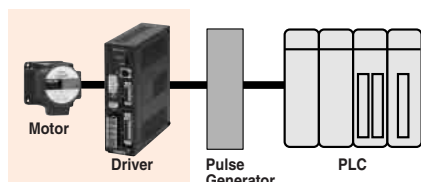
### Harmonic (HG) Geared

- High positioning precision
- High permissible/maximum torque
- Zero backlash
- High gear ratio, High resolution
- Centered output shaft
- Gear Ratios 50:1, 100:1

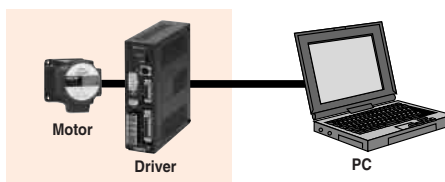
Step & Direction Input Type

or

Integrated Controller & Driver



Motor and driver are controlled with an external pulse generator.



No external pulse generator required.

## Product Line

| Type           | Power Supply Voltage     | Maximum Holding Torque           |                                |  |
|----------------|--------------------------|----------------------------------|--------------------------------|--|
|                |                          | □1.65 in. (□42 mm)               | □2.36 in. (□60 mm)             | □3.35 in. (□85 mm)<br>[Geared: □3.54 in. (□90 mm)] |
| Standard Type  | Single-Phase 100-115 VAC | ●                                | ●                              | ●  |
|                | Single-Phase 200-230 VAC | —                                | ●                              | ●  |
|                | Three-Phase 200-230 VAC  | —                                | ●                              | ●  |
|                |                          | 42 oz-in<br>(0.3 N·m)            | 170~280 oz-in<br>(1.2~2.0 N·m) | 280~560 oz-in<br>(2.0~4.0 N·m)                     |
| TH Geared Type | Single-Phase 100-115 VAC | ●                                | ●                              | ●  |
|                | Single-Phase 200-230 VAC | —                                | ●                              | ●  |
|                | Three-Phase 200-230 VAC  | —                                | ●                              | ●  |
|                |                          | 3.0~13.2 lb-in<br>(0.35~1.5 N·m) | 11.0~35 lb-in<br>(1.25~4 N·m)  | 39~106 lb-in<br>(4.5~12 N·m)                       |
| PN Geared Type | Single-Phase 100-115 VAC | ●                                | ●                              | ●  |
|                | Single-Phase 200-230 VAC | —                                | ●                              | ●  |
|                | Three-Phase 200-230 VAC  | —                                | ●                              | ●  |
|                |                          | 13.2 lb-in<br>(1.5 N·m)          | 30~70 lb-in<br>(3.5~8 N·m)     | 88~320 lb-in<br>(10~37 N·m)                        |
| HG Geared Type | Single-Phase 100-115 VAC | ●                                | ●                              | ●  |
|                | Single-Phase 200-230 VAC | —                                | ●                              | ●  |
|                | Three-Phase 200-230 VAC  | —                                | ●                              | ●  |
|                |                          | 30~44 lb-in<br>(3.5~5.0 N·m)     | 48~70 lb-in<br>(5.5~8.0 N·m)   | 220~320 lb-in<br>(25~37 N·m)                       |

● Electromagnetic brake models are also available.

**● Position Control**

- Incremental mode (relative distance specification)/Absolute mode (absolute position specification)
- Linked operation (a maximum of four motion profiles may be linked)
- Data range (in pulses): -8,388,608 to +8,388,607
- Operating speed: 10 Hz to 500 kHz (set in 1Hz increments)

**● Four Operation Modes**

1. Positioning
2. Mechanical home seeking (+LS, -LS, HOMELS)
3. Continuous
4. Electrical home seeking

**● General Inputs/Outputs**

- 8 Programmable Inputs
- 8 Programmable Outputs

**● Daisy Chain Capability**

- Up to 36 units can be daisy chained with unique device ID's

**● Communication**

- ASCII based commands
- Conforms to RS-232C communication specifications
- Start-stop asynchronous transmission method
- Transmission speed: 9,600 bps
- Data length: 8 bits, 1 stop bit, no parity
- Protocol: TTY (CR+LF)
- Modular 4-pin connector

**● Program Memory**

- Maximum number of programs: 14 (including STARTUP)
- Maximum lines per program: 64
- Commands per line: 1
- Program variables: 26 (A to Z)

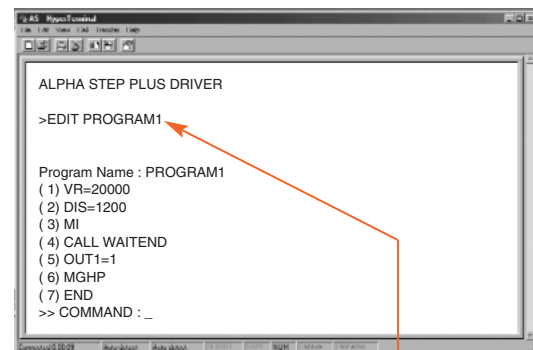
**● Built-in Functions**

- Selectable motor-resolution
- Run and stop current values
- Speed-filter set value
- Motor rotation direction
- Emergency stop
- Sensor logic
- Over-travel limits
- Software over-travel
- Alarm history
- Syntax checking
- Display values
- Incremental moves
- I/O status



Using Windows HyperTerminal®, programming the αSTEP Plus driver is a simple task.

**Example: "PROGRAM1"**

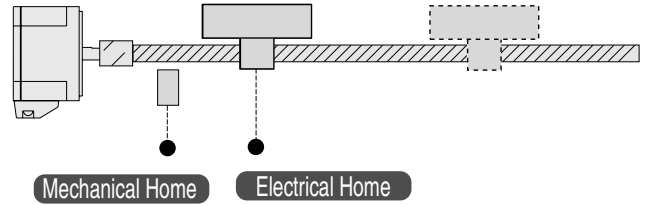
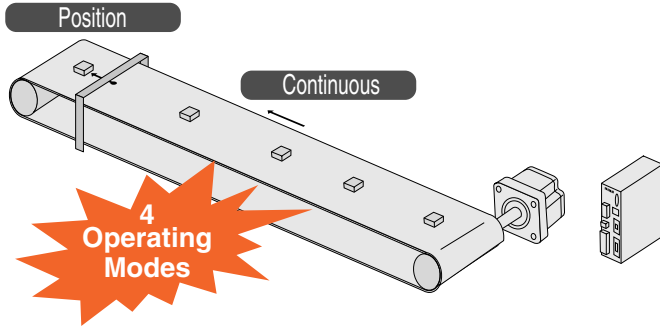


**PROGRAM1 Definition**

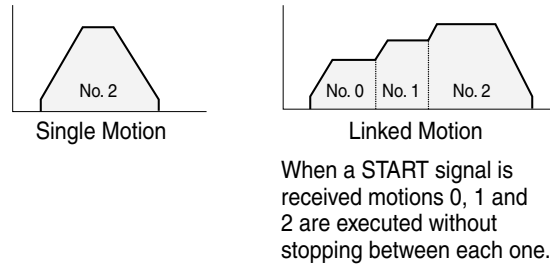
- Operating Speed: 20,000 Hz
- Move Distance: 1,200 pulses
- Call a subroutine that waits for the motor to stop before moving on to the next command
- Turn On Output #1
- Seek the Mechanical Home Position in the Positive Direction
- End of Program

## ■ $\alpha$ STEP Plus Features

### ● Operating Modes

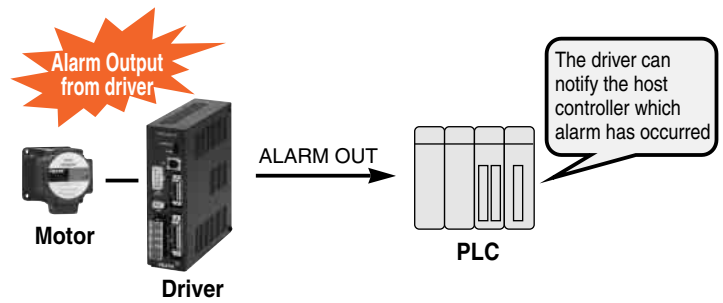


### ● Linked Motion Capability

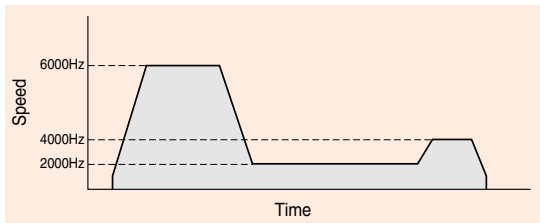


### ● Alarm Functions

The driver can flash LEDs to indicate which alarm has occurred.

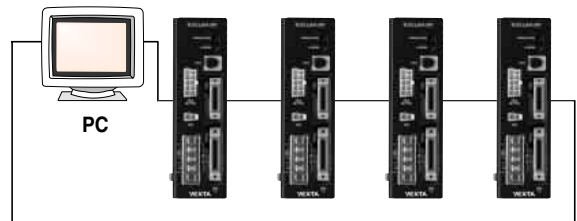


### ● Speed Change On The Fly



The running speed of the motor can be changed while the motor is in motion.

### ● Daisy Chain



Up to 36 units can be daisy chained via customer supplied cable.

## ■ Safety Standards and CE Marking

| Model | Standards   | Certification Body | File No.                | CE Marking                               |                              |
|-------|---|--------------------|-------------------------|--|------------------------------|
| Motor | UL1004<br>UL2111<br>CSA C22.2 No.100*3<br>CSA C22.2 No.77*3 | UL                 | E64199                  | Low Voltage Directives<br>EMC Directives |                              |
|       | EN60950<br>EN60034-1<br>EN60034-5                           |                    |                         |  | Conform to EN Standards      |
|       | Driver  |                    |                         |  | UL508C *1<br>CSA C22.2 No.14 |
|       | EN60950 *2<br>EN50178                                       |                    | Conform to EN Standards |  |                              |

• When the system is approved under various safety standards, the model names on the motor and driver nameplates are the approved model names.

**List of Motor and Driver Combinations** → Page C-53

**Details of Safety Standards** → Page G-2

• The EMC value changes according to the wiring and layout. Therefore, the final EMC level must be checked with the motor/driver incorporated in the user's equipment.

\*1 Maximum Ambient Temperature for UL

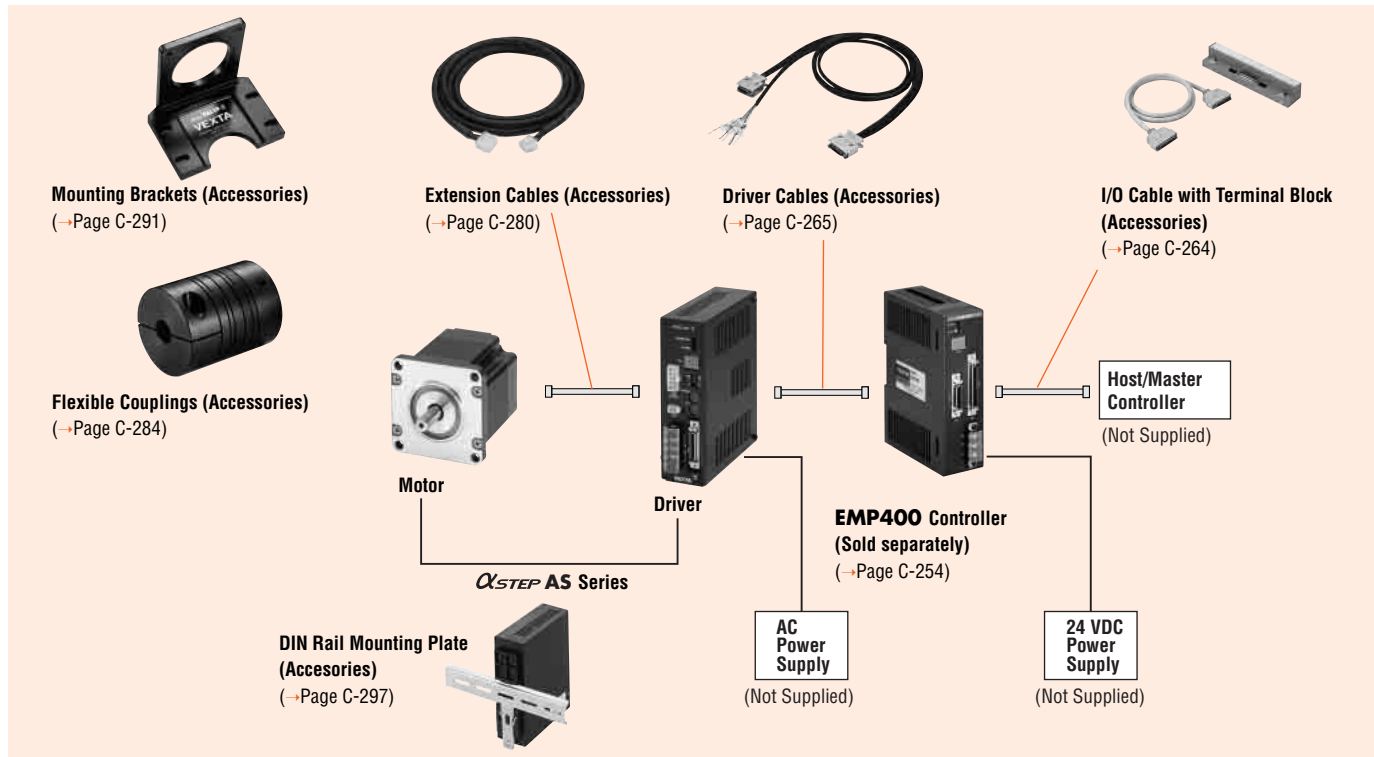
**AS:** 122°F (+50°C), **AS PLUS:** 104°F (+40°C)

\*2 EN60950 (Certified **AS** only)

\*3 Except for **AS46**□□ (Motor Frame Size 1.65 inch (42 mm)).

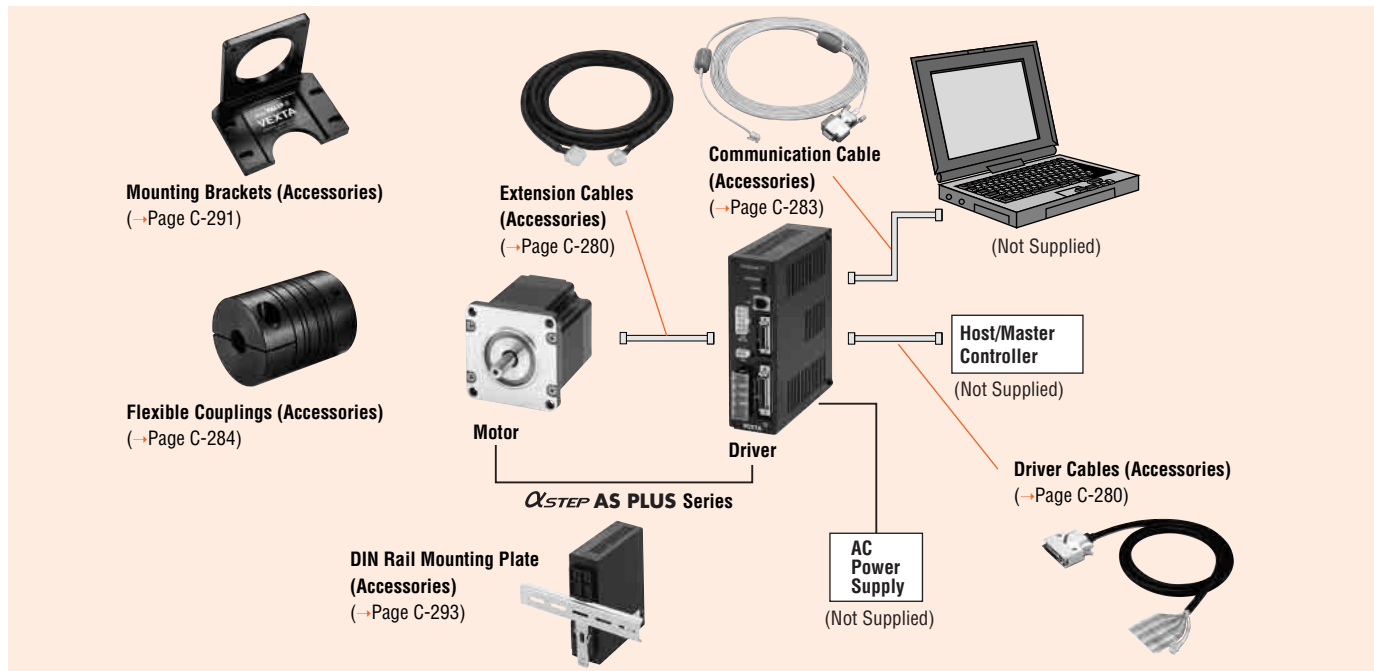
## System Configuration

### AS Series



An example of a single-axis system configuration with the **EMP400** Series controller.

### AS PLUS



The system configuration shown is an example. Other combinations are available.

## Extension Cables (For AS Series and AS PLUS Series)

Extension cables are not included with **αSTEP** products. When using the **αSTEP** stepping motor and driver more than 1.31 feet (0.4 m) apart from each other, use an optional extension cable (sold separately).

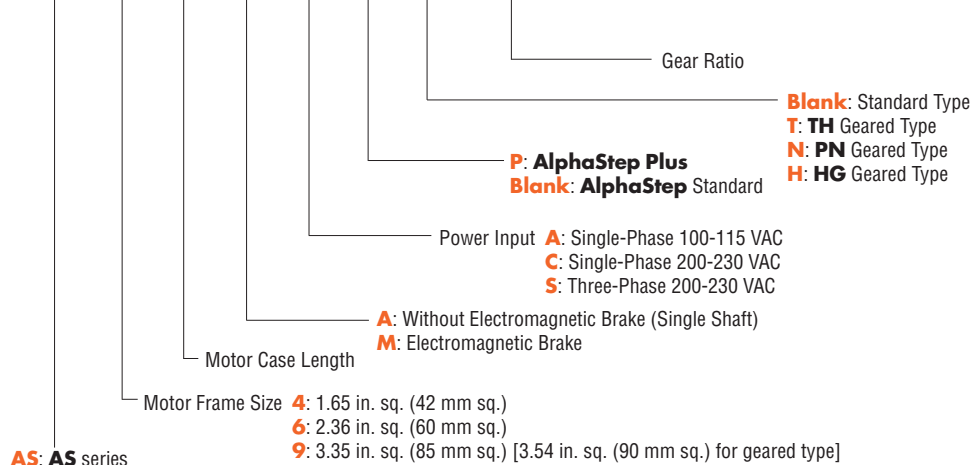
### Note:

- Electromagnetic brake motor models [except motor frame size □1.65 in. (□42 mm)] must use an optional electromagnetic brake extension cable. The frame size □1.65 in. (□42 mm) models can use a standard extension cable even for electromagnetic brake motor models.



## Product Number Code

# AS 6 6 A A P-T 3.6



## AS Product Lines

### AS Series

#### Standard Type

| Power Source                | Without Electromagnetic Brake                    |  |  | Electromagnetic Brake                            |  |  |
|-----------------------------|--|--|--|--|--|--|
|                             | Motor Frame Size:<br>□1.65 in. (□42 mm)<br>Model | Motor Frame Size:<br>□2.36 in. (□60 mm)<br>Model | Motor Frame Size:<br>□3.35 in. (□85 mm)<br>Model | Motor Frame Size:<br>□1.65 in. (□42 mm)<br>Model | Motor Frame Size:<br>□2.36 in. (□60 mm)<br>Model | Motor Frame Size:<br>□3.35 in. (□85 mm)<br>Model |
| Single-Phase<br>100-115 VAC | <b>AS46AA</b>                                    | <b>AS66AA</b>                                    | <b>AS98AA</b>                                    | <b>AS46MA</b>                                    | <b>AS66MA</b>                                    | <b>AS98MA</b>                                    |
|                             | —  | <b>AS69AA</b>                                    | <b>AS911AA</b>                                   | —  | <b>AS69MA</b>                                    | —  |
| Single-Phase<br>200-230 VAC | —  | <b>AS66AC</b>                                    | <b>AS98AC</b>                                    | —  | <b>AS66MC</b>                                    | <b>AS98MC</b>                                    |
|                             | —  | <b>AS69AC</b>                                    | <b>AS911AC</b>                                   | —  | <b>AS69MC</b>                                    | —  |
| Three-Phase<br>200-230 VAC  | —  | <b>AS66AS</b>                                    | <b>AS98AS</b>                                    | —  | <b>AS66MS</b>                                    | <b>AS98MS</b>                                    |
|                             | —  | <b>AS69AS</b>                                    | <b>AS911AS</b>                                   | —  | <b>AS69MS</b>                                    | —  |

#### TH Geared Type

| Power Source                | Without Electromagnetic Brake                    |  |  | Electromagnetic Brake                            |  |  |
|-----------------------------|--|--|--|--|--|--|
|                             | Motor Frame Size:<br>□1.65 in. (□42 mm)<br>Model | Motor Frame Size:<br>□2.36 in. (□60 mm)<br>Model | Motor Frame Size:<br>□3.54 in. (□90 mm)<br>Model | Motor Frame Size:<br>□1.65 in. (□42 mm)<br>Model | Motor Frame Size:<br>□2.36 in. (□60 mm)<br>Model | Motor Frame Size:<br>□3.54 in. (□90 mm)<br>Model |
| Single-Phase<br>100-115 VAC | <b>AS46AA-T3.6</b>                               | <b>AS66AA-T3.6</b>                               | <b>AS98AA-T3.6</b>                               | <b>AS46MA-T3.6</b>                               | <b>AS66MA-T3.6</b>                               | <b>AS98MA-T3.6</b>                               |
|                             | <b>AS46AA-T7.2</b>                               | <b>AS66AA-T7.2</b>                               | <b>AS98AA-T7.2</b>                               | <b>AS46MA-T7.2</b>                               | <b>AS66MA-T7.2</b>                               | <b>AS98MA-T7.2</b>                               |
|                             | <b>AS46AA-T10</b>                                | <b>AS66AA-T10</b>                                | <b>AS98AA-T10</b>                                | <b>AS46MA-T10</b>                                | <b>AS66MA-T10</b>                                | <b>AS98MA-T10</b>                                |
|                             | <b>AS46AA-T20</b>                                | <b>AS66AA-T20</b>                                | <b>AS98AA-T20</b>                                | <b>AS46MA-T20</b>                                | <b>AS66MA-T20</b>                                | <b>AS98MA-T20</b>                                |
|                             | <b>AS46AA-T30</b>                                | <b>AS66AA-T30</b>                                | <b>AS98AA-T30</b>                                | <b>AS46MA-T30</b>                                | <b>AS66MA-T30</b>                                | <b>AS98MA-T30</b>                                |
| Single-Phase<br>200-230 VAC | —  | <b>AS66AC-T3.6</b>                               | <b>AS98AC-T3.6</b>                               | —  | <b>AS66MC-T3.6</b>                               | <b>AS98MC-T3.6</b>                               |
|                             | —  | <b>AS66AC-T7.2</b>                               | <b>AS98AC-T7.2</b>                               | —  | <b>AS66MC-T7.2</b>                               | <b>AS98MC-T7.2</b>                               |
|                             | —  | <b>AS66AC-T10</b>                                | <b>AS98AC-T10</b>                                | —  | <b>AS66MC-T10</b>                                | <b>AS98MC-T10</b>                                |
|                             | —  | <b>AS66AC-T20</b>                                | <b>AS98AC-T20</b>                                | —  | <b>AS66MC-T20</b>                                | <b>AS98MC-T20</b>                                |
|                             | —  | <b>AS66AC-T30</b>                                | <b>AS98AC-T30</b>                                | —  | <b>AS66MC-T30</b>                                | <b>AS98MC-T30</b>                                |
| Three-Phase<br>200-230 VAC  | —  | <b>AS66AS-T3.6</b>                               | <b>AS98AS-T3.6</b>                               | —  | <b>AS66MS-T3.6</b>                               | <b>AS98MS-T3.6</b>                               |
|                             | —  | <b>AS66AS-T7.2</b>                               | <b>AS98AS-T7.2</b>                               | —  | <b>AS66MS-T7.2</b>                               | <b>AS98MS-T7.2</b>                               |
|                             | —  | <b>AS66AS-T10</b>                                | <b>AS98AS-T10</b>                                | —  | <b>AS66MS-T10</b>                                | <b>AS98MS-T10</b>                                |
|                             | —  | <b>AS66AS-T20</b>                                | <b>AS98AS-T20</b>                                | —  | <b>AS66MS-T20</b>                                | <b>AS98MS-T20</b>                                |
|                             | —  | <b>AS66AS-T30</b>                                | <b>AS98AS-T30</b>                                | —  | <b>AS66MS-T30</b>                                | <b>AS98MS-T30</b>                                |





## ◆ TH Geared Type

| Power Source                | Without Electromagnetic Brake                    |  |  | Electromagnetic Brake                            |  |  |
|-----------------------------|--|--|--|--|--|--|
|                             | Motor Frame Size:<br>□1.65 in. (□42 mm)<br>Model | Motor Frame Size:<br>□2.36 in. (□60 mm)<br>Model | Motor Frame Size:<br>□3.54 in. (□90 mm)<br>Model | Motor Frame Size:<br>□1.65 in. (□42 mm)<br>Model | Motor Frame Size:<br>□2.36 in. (□60 mm)<br>Model | Motor Frame Size:<br>□3.54 in. (□90 mm)<br>Model |
| Single-Phase<br>100-115 VAC | <b>AS46AAP-T3.6</b>                              | <b>AS66AAP-T3.6</b>                              | <b>AS98AAP-T3.6</b>                              | <b>AS46MAP-T3.6</b>                              | <b>AS66MAP-T3.6</b>                              | <b>AS98MAP-T3.6</b>                              |
|                             | <b>AS46AAP-T7.2</b>                              | <b>AS66AAP-T7.2</b>                              | <b>AS98AAP-T7.2</b>                              | <b>AS46MAP-T7.2</b>                              | <b>AS66MAP-T7.2</b>                              | <b>AS98MAP-T7.2</b>                              |
|                             | <b>AS46AAP-T10</b>                               | <b>AS66AAP-T10</b>                               | <b>AS98AAP-T10</b>                               | <b>AS46MAP-T10</b>                               | <b>AS66MAP-T10</b>                               | <b>AS98MAP-T10</b>                               |
|                             | <b>AS46AAP-T20</b>                               | <b>AS66AAP-T20</b>                               | <b>AS98AAP-T20</b>                               | <b>AS46MAP-T20</b>                               | <b>AS66MAP-T20</b>                               | <b>AS98MAP-T20</b>                               |
|                             | <b>AS46AAP-T30</b>                               | <b>AS66AAP-T30</b>                               | <b>AS98AAP-T30</b>                               | <b>AS46MAP-T30</b>                               | <b>AS66MAP-T30</b>                               | <b>AS98MAP-T30</b>                               |
| Single-Phase<br>200-230 VAC | —  | <b>AS66ACP-T3.6</b>                              | <b>AS98ACP-T3.6</b>                              | —  | <b>AS66MCP-T3.6</b>                              | <b>AS98MCP-T3.6</b>                              |
|                             | —  | <b>AS66ACP-T7.2</b>                              | <b>AS98ACP-T7.2</b>                              | —  | <b>AS66MCP-T7.2</b>                              | <b>AS98MCP-T7.2</b>                              |
|                             | —  | <b>AS66ACP-T10</b>                               | <b>AS98ACP-T10</b>                               | —  | <b>AS66MCP-T10</b>                               | <b>AS98MCP-T10</b>                               |
|                             | —  | <b>AS66ACP-T20</b>                               | <b>AS98ACP-T20</b>                               | —  | <b>AS66MCP-T20</b>                               | <b>AS98MCP-T20</b>                               |
|                             | —  | <b>AS66ACP-T30</b>                               | <b>AS98ACP-T30</b>                               | —  | <b>AS66MCP-T30</b>                               | <b>AS98MCP-T30</b>                               |
| Three-Phase<br>200-230 VAC  | —  | <b>AS66ASP-T3.6</b>                              | <b>AS98ASP-T3.6</b>                              | —  | <b>AS66MSP-T3.6</b>                              | <b>AS98MSP-T3.6</b>                              |
|                             | —  | <b>AS66ASP-T7.2</b>                              | <b>AS98ASP-T7.2</b>                              | —  | <b>AS66MSP-T7.2</b>                              | <b>AS98MSP-T7.2</b>                              |
|                             | —  | <b>AS66ASP-T10</b>                               | <b>AS98ASP-T10</b>                               | —  | <b>AS66MSP-T10</b>                               | <b>AS98MSP-T10</b>                               |
|                             | —  | <b>AS66ASP-T20</b>                               | <b>AS98ASP-T20</b>                               | —  | <b>AS66MSP-T20</b>                               | <b>AS98MSP-T20</b>                               |
|                             | —  | <b>AS66ASP-T30</b>                               | <b>AS98ASP-T30</b>                               | —  | <b>AS66MSP-T30</b>                               | <b>AS98MSP-T30</b>                               |

## ◆ PN Geared Type

| Power Source                | Without Electromagnetic Brake                    |  |  | Electromagnetic Brake                            |  |  |
|-----------------------------|--|--|--|--|--|--|
|                             | Motor Frame Size:<br>□1.65 in. (□42 mm)<br>Model | Motor Frame Size:<br>□2.36 in. (□60 mm)<br>Model | Motor Frame Size:<br>□3.54 in. (□90 mm)<br>Model | Motor Frame Size:<br>□1.65 in. (□42 mm)<br>Model | Motor Frame Size:<br>□2.36 in. (□60 mm)<br>Model | Motor Frame Size:<br>□3.54 in. (□90 mm)<br>Model |
| Single-Phase<br>100-115 VAC | —  | <b>AS66AAP-N5</b>                                | <b>AS98AAP-N5</b>                                | —  | <b>AS66MAP-N5</b>                                | <b>AS98MAP-N5</b>                                |
|                             | <b>AS46AAP-N7.2</b>                              | <b>AS66AAP-N7.2</b>                              | <b>AS98AAP-N7.2</b>                              | <b>AS46MAP-N7.2</b>                              | <b>AS66MAP-N7.2</b>                              | <b>AS98MAP-N7.2</b>                              |
|                             | <b>AS46AAP-N10</b>                               | <b>AS66AAP-N10</b>                               | <b>AS98AAP-N10</b>                               | <b>AS46MAP-N10</b>                               | <b>AS66MAP-N10</b>                               | <b>AS98MAP-N10</b>                               |
|                             | —  | <b>AS66AAP-N25</b>                               | <b>AS98AAP-N25</b>                               | —  | <b>AS66MAP-N25</b>                               | <b>AS98MAP-N25</b>                               |
|                             | —  | <b>AS66AAP-N36</b>                               | <b>AS98AAP-N36</b>                               | —  | <b>AS66MAP-N36</b>                               | <b>AS98MAP-N36</b>                               |
|                             | —  | <b>AS66AAP-N50</b>                               | <b>AS98AAP-N50</b>                               | —  | <b>AS66MAP-N50</b>                               | <b>AS98MAP-N50</b>                               |
| Single-Phase<br>200-230 VAC | —  | <b>AS66ACP-N5</b>                                | <b>AS98ACP-N5</b>                                | —  | <b>AS66MCP-N5</b>                                | <b>AS98MCP-N5</b>                                |
|                             | —  | <b>AS66ACP-N7.2</b>                              | <b>AS98ACP-N7.2</b>                              | —  | <b>AS66MCP-N7.2</b>                              | <b>AS98MCP-N7.2</b>                              |
|                             | —  | <b>AS66ACP-N10</b>                               | <b>AS98ACP-N10</b>                               | —  | <b>AS66MCP-N10</b>                               | <b>AS98MCP-N10</b>                               |
|                             | —  | <b>AS66ACP-N25</b>                               | <b>AS98ACP-N25</b>                               | —  | <b>AS66MCP-N25</b>                               | <b>AS98MCP-N25</b>                               |
|                             | —  | <b>AS66ACP-N36</b>                               | <b>AS98ACP-N36</b>                               | —  | <b>AS66MCP-N36</b>                               | <b>AS98MCP-N36</b>                               |
|                             | —  | <b>AS66ACP-N50</b>                               | <b>AS98ACP-N50</b>                               | —  | <b>AS66MCP-N50</b>                               | <b>AS98MCP-N50</b>                               |
| Three-Phase<br>200-230 VAC  | —  | <b>AS66ASP-N5</b>                                | <b>AS98ASP-N5</b>                                | —  | <b>AS66MSP-N5</b>                                | <b>AS98MSP-N5</b>                                |
|                             | —  | <b>AS66ASP-N7.2</b>                              | <b>AS98ASP-N7.2</b>                              | —  | <b>AS66MSP-N7.2</b>                              | <b>AS98MSP-N7.2</b>                              |
|                             | —  | <b>AS66ASP-N10</b>                               | <b>AS98ASP-N10</b>                               | —  | <b>AS66MSP-N10</b>                               | <b>AS98MSP-N10</b>                               |
|                             | —  | <b>AS66ASP-N25</b>                               | <b>AS98ASP-N25</b>                               | —  | <b>AS66MSP-N25</b>                               | <b>AS98MSP-N25</b>                               |
|                             | —  | <b>AS66ASP-N36</b>                               | <b>AS98ASP-N36</b>                               | —  | <b>AS66MSP-N36</b>                               | <b>AS98MSP-N36</b>                               |
|                             | —  | <b>AS66ASP-N50</b>                               | <b>AS98ASP-N50</b>                               | —  | <b>AS66MSP-N50</b>                               | <b>AS98MSP-N50</b>                               |

## ◆ HG Geared Type

| Power Source                | Without Electromagnetic Brake                    |  |  | Electromagnetic Brake                            |  |  |
|-----------------------------|--|--|--|--|--|--|
|                             | Motor Frame Size:<br>□1.65 in. (□42 mm)<br>Model | Motor Frame Size:<br>□2.36 in. (□60 mm)<br>Model | Motor Frame Size:<br>□3.54 in. (□90 mm)<br>Model | Motor Frame Size:<br>□1.65 in. (□42 mm)<br>Model | Motor Frame Size:<br>□2.36 in. (□60 mm)<br>Model | Motor Frame Size:<br>□3.54 in. (□90 mm)<br>Model |
| Single-Phase<br>100-115 VAC | <b>AS46AAP2-H50</b>                              | <b>AS66AAP2-H50</b>                              | <b>AS98AAP-H50</b>                               | <b>AS46MAP2-H50</b>                              | <b>AS66MAP2-H50</b>                              | <b>AS98MAP-H50</b>                               |
|                             | <b>AS46AAP2-H100</b>                             | <b>AS66AAP2-H100</b>                             | <b>AS98AAP-H100</b>                              | <b>AS46MAP2-H100</b>                             | <b>AS66MAP2-H100</b>                             | <b>AS98MAP-H100</b>                              |
| Single-Phase<br>200-230 VAC | —  | <b>AS66ACP2-H50</b>                              | <b>AS98ACP-H50</b>                               | —  | <b>AS66MCP2-H50</b>                              | <b>AS98MCP-H50</b>                               |
|                             | —  | <b>AS66ACP2-H100</b>                             | <b>AS98ACP-H100</b>                              | —  | <b>AS66MCP2-H100</b>                             | <b>AS98MCP-H100</b>                              |
| Three-Phase<br>200-230 VAC  | —  | <b>AS66ASP2-H50</b>                              | <b>AS98ASP-H50</b>                               | —  | <b>AS66MSP2-H50</b>                              | <b>AS98MSP-H50</b>                               |
|                             | —  | <b>AS66ASP2-H100</b>                             | <b>AS98ASP-H100</b>                              | —  | <b>AS66MSP2-H100</b>                             | <b>AS98MSP-H100</b>                              |

# Standard Type Motor Frame Size: 1.65 in. ( 42 mm), 2.36 in. ( 60 mm), 3.35 in. ( 85 mm)

## Specifications

\*Only the driver conforms to the CSA standard for **AS46** type motors.



| Model*1                 | AS   |          | AS46AA   | AS66A□   | AS69A□   | AS98A□   | AS911A□                       |
|-------------------------|--|----------|--|--|--|--|-------------------------------|
|                         | AS PLUS                                    |          | AS46MA   | AS66M□   | AS69M□   | AS98M□   | —                             |
|                         | W/O Electromagnetic Brake                  |          | AS46AAP  | AS66A□P  | AS69A□P  | AS98A□P  | AS911A□P                      |
|                         | Electromagnetic Brake                      |          | AS46MAP  | AS66M□P  | AS69M□P  | AS98M□P  | —                             |
| Maximum Holding Torque  | oz-in (N·m)                                |          | 42 (0.3)   | 170 (1.2)  | 280 (2.0)  | 280 (2.0)  | 560 (4.0)                     |
| Rotor Inertia*2 J       | oz-in <sup>2</sup> (kg·m <sup>2</sup> )    |          | 0.37 (68×10 <sup>-7</sup> )<br>[0.45 (83×10 <sup>-7</sup> )]   | 2.2 (405×10 <sup>-7</sup> )<br>[3.1 (564×10 <sup>-7</sup> )] | 4.4 (802×10 <sup>-7</sup> )<br>[5.3 (961×10 <sup>-7</sup> )] | 7.7 (1400×10 <sup>-7</sup> )<br>[8.5 (1560×10 <sup>-7</sup> )] | 14.8 (2710×10 <sup>-7</sup> ) |
| Resolution*4            | 0.36°/Pulse (Resolution Setting: 1000 P/R) |          |  |  |  |  |                               |
| Power Source            | Voltage-Frequency                          |          | □=A for Single-Phase 100-115 VAC -15%~+10% · 50/60 Hz<br>□=C for Single-Phase 200-230 VAC -15%~+10% · 50/60 Hz<br>□=S for Three-Phase 200-230 VAC -15%~+10% · 50/60 Hz |  |  |  |                               |
| Maximum Input Current   | Single-Phase 100-115 VAC                   |          | 3.3 A  | 5.0 A  | 6.4 A  | 6.0 A  | 6.5 A                         |
|                         | Single-Phase 200-230 VAC                   |          | —  | 3.0 A  | 3.9 A  | 3.5 A  | 4.5 A                         |
|                         | Three-Phase 200-230 VAC                    |          | —  | 1.5 A  | 2.2 A  | 1.9 A  | 2.4 A                         |
| Electromagnetic Brake*3 | Type                                       |          | Active when power is off   |  |  |  | —                             |
|                         | Power Supply Input                         |          | 24 VDC±5%  |  |  |  | —                             |
|                         | Power Consumption                          |          | 2 W  |  |  |  | —                             |
|                         | Excitation Current                         |          | 0.08 A   |  |  |  | 0.25 A                        |
| Weight*2                | Static Friction Torque oz-in (N·m)         |          | 21 (0.15)  | 85 (0.6)   | 142 (1.0)  | 142 (1.0)  | —                             |
|                         | Motor                                      | lb. (kg) | 1.1 (0.5) [1.3 (0.6)]  | 1.9 (0.85) [2.4 (1.1)]                                       | 3.1 (1.4) [3.6 (1.65)]                                       | 4.0 (1.8) [4.8 (2.2)]  | 6.6 (3.0)                     |
| Dimension No.           | Driver                                     |          | AS=13 AS PLUS=14   |  |  |  |                               |

\*1 The square box in the model number will contain one of the following letters to indicate the power supply voltage: **A** (Single-Phase 100-115 VAC), **C** (Single-Phase 200-230 VAC) or **S** (Three-Phase 200-230 VAC).

\*2 The values inside the brackets [ ] represents the specification for electromagnetic brake type.

\*3 The electromagnetic brakes are for holding the position when the power is off. They can not be used for complicated braking.

Also, a separate 24 VDC ±5%, 0.3 A min. power supply is required for the electromagnetic brake, along with the accessory electromagnetic brake type extension cable. For motor frame size  1.65 in. ( 42 mm), use the standard type extension cable.

\*4 **AS** series: The resolution can be set to any one of 500 P/R, 1000 P/R, 5000 P/R, 10000 P/R with the resolution select switch or resolution select switching signals. See page C-39 for details.

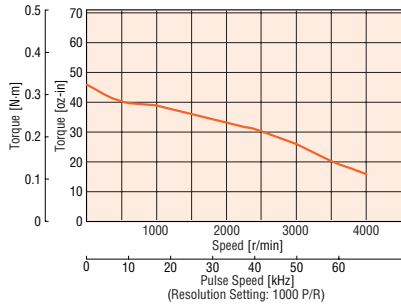
**AS PLUS:** The resolution can be set from 500 P/R to 10000 P/R by setting parameters.

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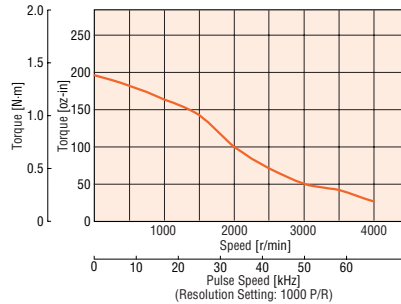
## Speed — Torque Characteristics

How to Read Speed-Torque Characteristics →Page C-10

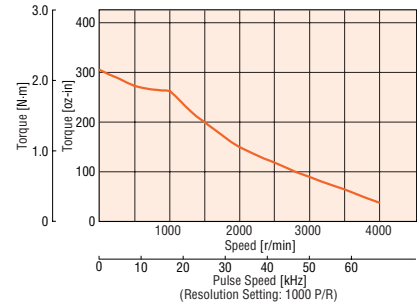
AS46□A, AS46□AP



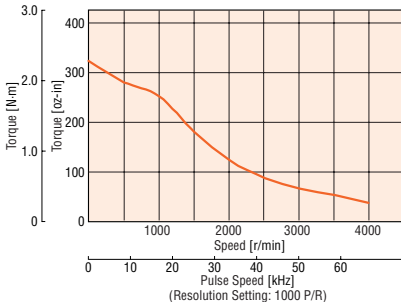
AS66□□, AS66□□P



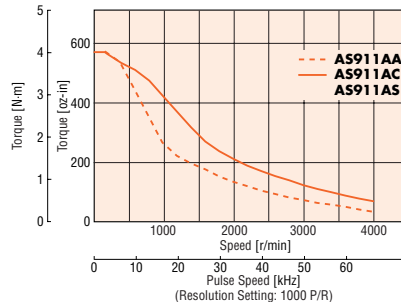
AS69□□, AS69□□P



AS98□□, AS98□□P



AS911A□, AS911A□P



### Notes:

- Pay attention to heat dissipation from motor and driver. In particular, remember that the motor will produce a considerable amount of heat under certain conditions. Be sure to keep the temperature of the motor case under 212°F (100°C). [Under 176°F (75°C) is required to comply with UL or CSA standards.]
- When using the motor with the dedicated driver, the driver's automatic current cutback at motor standstill function reduces maximum holding torque by approximately 50%.

# TH Geared Type

Motor Frame Size:  1.65 in. ( 42 mm)

## Specifications

\*Only the driver conforms to the CSA standard for **AS46** type motors.



| Model                   | AS                                      |        | AS46AA-T3.6   | AS46AA-T7.2      | AS46AA-T10   | AS46AA-T20   | AS46AA-T30   |  |
|-------------------------|---|--------|---|------------------|--------------|--------------|--------------|--|
|                         | AS PLUS                                 |        | AS46AAP-T3.6  | AS46AAP-T7.2     | AS46AAP-T10  | AS46AAP-T20  | AS46AAP-T30  |  |
| Maximum Holding Torque  | lb-in (N·m)                             |        | 3 (0.35)  | 6.1 (0.7)        | 8.8 (1)      | 13.2 (1.5)   | 13.2 (1.5)   |  |
| Rotor Inertia*2 J       | oz-in <sup>2</sup> (kg·m <sup>2</sup> ) |        | 0.37 (68×10 <sup>-7</sup> ) [0.45 (83×10 <sup>-7</sup> )] |                  |              |              |              |  |
| Backlash                | arc min (degrees)                       |        | 45 (0.75°)  | 25 (0.417°)      | 25 (0.417°)  | 15 (0.25°)   | 15 (0.25°)   |  |
| Permissible Speed Range | r/min                                   |        | 0~500   | 0~250            | 0~180        | 0~90         | 0~60         |  |
| Gear Ratio              |   |        | 3.6 : 1   | 7.2 : 1          | 10 : 1       | 20 : 1       | 30 : 1       |  |
| Resolution*4            | 1000 P/R                                |        | 0.1°/pulse  | 0.05°/pulse      | 0.036°/pulse | 0.018°/pulse | 0.012°/pulse |  |
| Permissible Torque      | lb-in (N·m)                             |        | 3 (0.35)  | 6.1 (0.7)        | 8.8 (1)      | 13.2 (1.5)   | 13.2 (1.5)   |  |
| Power Source            | Voltage-Frequency-Maximum Input Current |        | Single-Phase 100-115 VAC -15%~+10% · 50/60 Hz-3.3 A       |                  |              |              |              |  |
| Electromagnetic Brake*3 | Type                                    |        | Active when power is off                                  |                  |              |              |              |  |
|                         | Power Supply Input                      |        | 24 VDC ±5%  |                  |              |              |              |  |
|                         | Power Consumption                       |        | 2 W   |                  |              |              |              |  |
|                         | Excitation Current                      |        | 0.08 A  |                  |              |              |              |  |
| Weight*2                | Static Friction Torque lb-in (N·m)      |        | 1.5 (0.17)  | 3 (0.35)         | 4.4 (0.5)    | 6.6 (0.75)   | 6.6 (0.75)   |  |
|                         | Motor lb. (kg)                          |        | 1.4 (0.65) [1.7 (0.75)]                                   |                  |              |              |              |  |
| Dimension No.           | Driver lb. (kg)                         |        | 1.8 (0.8)   |                  |              |              |              |  |
|                         | Motor                                   |        | 4   |                  |              |              |              |  |
|                         |   | Driver |   | AS=13 AS PLUS=14 |              |              |              |  |

\*2 The values inside the brackets [ ] represents the specification for electromagnetic brake type.

\*3 The electromagnetic brakes are for holding the position when the power is off. They can not be used for complicated braking.

Also, a separate 24 VDC ±5%, 0.3 A min. power supply is required for the electromagnetic brake, along with the accessory standard type extension cable.

\*4 **AS** series: The resolution can be set to any one of 500 P/R, 1000 P/R, 5000 P/R, 10000 P/R with the resolution select switch or resolution select switching signals. See page C-39 for details.

**AS PLUS:** The resolution can be set from 500 P/R to 10000 P/R by setting parameters.

**How to Read Specifications Table**→Page C-9

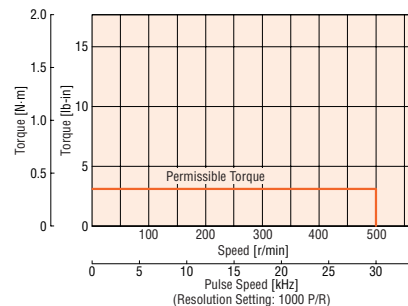
### Note:

- Direction of rotation of the motor and that of the gear output shaft are the same for unit type with reduction ratio 3.6:1, 7.2:1 and 10:1. It is opposite for 20:1 and 30:1 ratio type.

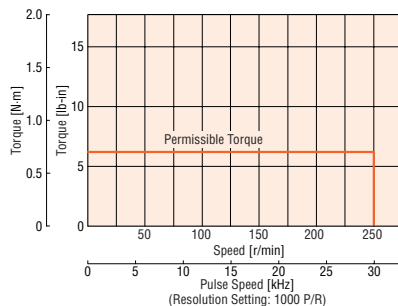
## Speed — Torque Characteristics

How to Read Speed-Torque Characteristics→Page C-10

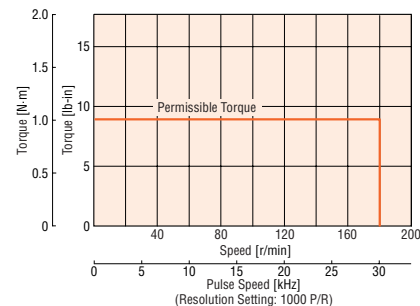
AS46□A-T3.6, AS46□AP-T3.6



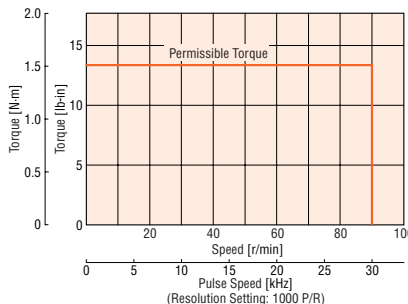
AS46□A-T7.2, AS46□AP-T7.2



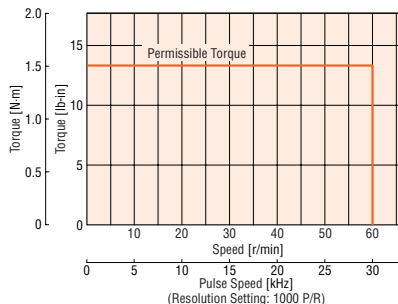
AS46□A-T10, AS46□AP-T10



AS46□A-T20, AS46□AP-T20



AS46□A-T30, AS46□AP-T30



### Notes:

- Pay attention to heat dissipation from motor and driver. In particular, remember that the motor will produce a considerable amount of heat under certain conditions. Be sure to keep the temperature of the motor case under 212°F (100°C). [Under 176°F (75°C) is required to comply with UL or CSA standards.]
- When using the motor with the dedicated driver, the driver's automatic current cutback at motor standstill function reduces maximum holding torque by approximately 50%.

# TH Geared Type

Motor Frame Size: □ 2.36 in. (□ 60 mm)



## Specifications

| Model*1                 | AS                                      |                  | AS66A□-T3.6  | AS66A□-T7.2 | AS66A□-T10   | AS66A□-T20   | AS66A□-T30   |
|-------------------------|---|------------------|--|-------------|--------------|--------------|--------------|
|                         | AS PLUS                                 |                  | AS66M□-T3.6  | AS66M□-T7.2 | AS66M□-T10   | AS66M□-T20   | AS66M□-T30   |
| Maximum Holding Torque  | lb-in (N·m)                             |                  | 11 (1.25)  | 22 (2.5)    | 26 (3)       | 30 (3.5)     | 35 (4)       |
| Rotor Inertia*2 J       | oz-in <sup>2</sup> (kg·m <sup>2</sup> ) |                  | 2.2 (405×10 <sup>-7</sup> ) [3.1 (564×10 <sup>-7</sup> )]  |             |              |              |              |
| Backlash                | arc min (degrees)                       |                  | 35 (0.584°)  | 15 (0.25°)  | 15 (0.25°)   | 10 (0.167°)  | 10 (0.167°)  |
| Permissible Speed Range | r/min                                   |                  | 0~500  | 0~250       | 0~180        | 0~90         | 0~60         |
| Gear Ratio              |   |                  | 3.6 : 1  | 7.2 : 1     | 10 : 1       | 20 : 1       | 30 : 1       |
| Resolution*4            | 1000 P/R                                |                  | 0.1°/pulse   | 0.05°/pulse | 0.036°/pulse | 0.018°/pulse | 0.012°/pulse |
| Permissible Torque      | lb-in (N·m)                             |                  | 11 (1.25)  | 22 (2.5)    | 26 (3)       | 30 (3.5)     | 35 (4)       |
| Power Source            | Voltage-Frequency-Maximum Input Current |                  | □=A For Single-Phase 100-115 VAC -15%~+10% · 50/60 Hz·5.0 A<br>□=C For Single-Phase 200-230 VAC -15%~+10% · 50/60 Hz·3.0 A<br>□=S For Three-Phase 200-230 VAC -15%~+10% · 50/60 Hz·1.5 A |             |              |              |              |
| Electromagnetic Brake*3 | Type                                    |                  | Active when power is off   |             |              |              |              |
|                         | Power Supply Input                      |                  | 24 VDC±5%  |             |              |              |              |
|                         | Power Consumption                       |                  | 6 W  |             |              |              |              |
| Weight*2                | Excitation Current                      |                  | 0.25 A   |             |              |              |              |
|                         | Static Friction Torque lb-in (N·m)      |                  | 5.4 (0.62)   | 11 (1.25)   | 13.2 (1.5)   | 15.4 (1.75)  | 17.7 (2.0)   |
| Dimension No.           | Motor lb. (kg)                          |                  | 2.8 (1.25) [3.3 (1.5)]   |             |              |              |              |
|                         | Driver lb. (kg)                         |                  | 1.8 (0.8)  |             |              |              |              |
| Motor                   |   | 5                |  |             |              |              |              |
| Driver                  |   | AS=13 AS PLUS=14 |  |             |              |              |              |

\*1 The square box in the model number will contain one of the following letters to indicate the power supply voltage: **A** (Single-Phase 100-115 VAC), **C** (Single-Phase 200-230 VAC) or **S** (Three-Phase 200-230 VAC).

\*2 The values inside the brackets [ ] represents the specification for electromagnetic brake type.

\*3 The electromagnetic brakes are for holding the position when the power is off. They can not be used for complicated braking.

Also, a separate 24 VDC ±5%, 0.3 A min. power supply is required for the electromagnetic brake, along with the accessory electromagnetic brake type extension cable.

\*4 **AS** series: The resolution can be set to any one of 500 P/R, 1000 P/R, 5000 P/R, 10000 P/R with the resolution select switch or resolution select switching signals. See page C-39 for details.

**AS PLUS:** The resolution can be set from 500 P/R to 10000 P/R by setting parameters.

How to Read Specifications Table → Page C-9

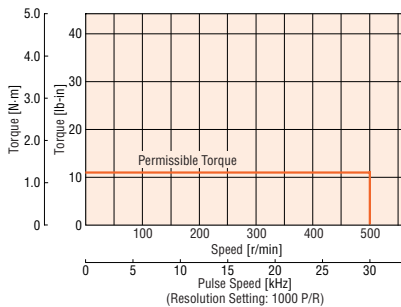
### Note:

- Direction of rotation of the motor and that of the gear output shaft are the same for unit type with reduction ratio 3.6:1, 7.2:1 and 10:1. It is opposite for 20:1 and 30:1 ratio type.

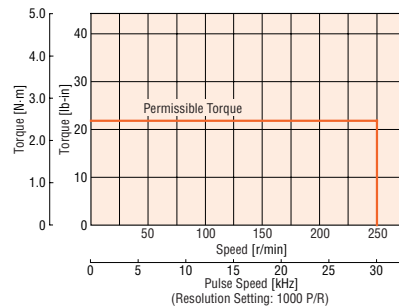
## Speed — Torque Characteristics

How to Read Speed-Torque Characteristics → Page C-10

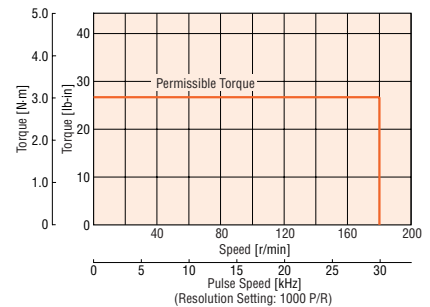
AS66□□-T3.6, AS66□□P-T3.6



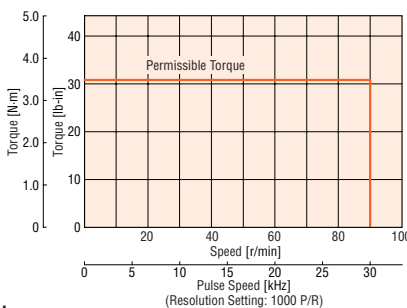
AS66□□-T7.2, AS66□□P-T7.2



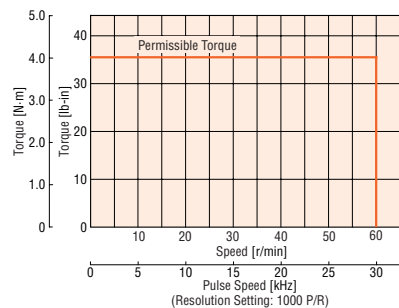
AS66□□-T10, AS66□□P-T10



AS66□□-T20, AS66□□P-T20



AS66□□-T30, AS66□□P-T30



### Notes:

- Pay attention to heat dissipation from motor and driver. In particular, remember that the motor will produce a considerable amount of heat under certain conditions. Be sure to keep the temperature of the motor case under 212°F (100°C). [Under 176°F (75°C) is required to comply with UL or CSA standards.]
- When using the motor with the dedicated driver, the driver's automatic current cutback at motor standstill function reduces maximum holding torque by approximately 50%.

# TH Geared Type

Motor Frame Size: □ 3.54 in. (□ 90 mm)



## Specifications

| Model*1                 | AS                                      |  | AS98A□-T3.6  | AS98A□-T7.2  | AS98A□-T10   | AS98A□-T20   | AS98A□-T30   |
|-------------------------|---|--|--|--------------|--------------|--------------|--------------|
|                         | AS PLUS                                 |  | AS98A□P-T3.6   | AS98A□P-T7.2 | AS98A□P-T10  | AS98A□P-T20  | AS98A□P-T30  |
| Maximum Holding Torque  | lb-in (N·m)                             |  | 39 (4.5)   | 79 (9)       | 79 (9)       | 106 (12)     | 106 (12)     |
| Rotor Inertia*2 J       | oz-in <sup>2</sup> (kg·m <sup>2</sup> ) |  | 7.7 (1400×10 <sup>-7</sup> ) [8.5 (1560×10 <sup>-7</sup> )]  |              |              |              |              |
| Backlash                | arc min (degrees)                       |  | 25 (0.417°)  | 15 (0.25°)   | 15 (0.25°)   | 10 (0.167°)  | 10 (0.167°)  |
| Permissible Speed Range | r/min                                   |  | 0~500  | 0~250        | 0~180        | 0~90         | 0~60         |
| Gear Ratio              |   |  | 3.6 : 1  | 7.2 : 1      | 10 : 1       | 20 : 1       | 30 : 1       |
| Resolution*4            | 1000 P/R                                |  | 0.1°/pulse   | 0.05°/pulse  | 0.036°/pulse | 0.018°/pulse | 0.012°/pulse |
| Permissible Torque      | lb-in (N·m)                             |  | 39 (4.5)   | 79 (9)       | 79 (9)       | 106 (12)     | 106 (12)     |
| Power Source            | Voltage-Frequency-Maximum Input Current |  | <input type="checkbox"/> =A for Single-Phase 100-115 VAC -15%~+10% · 50/60 Hz·6.0 A<br><input type="checkbox"/> =C for Single-Phase 200-230 VAC -15%~+10% · 50/60 Hz·3.5 A<br><input type="checkbox"/> =S for Three-Phase 200-230 VAC -15%~+10% · 50/60 Hz·1.9 A |              |              |              |              |
| Electromagnetic Brake*3 | Type                                    |  | Active when power is off   |              |              |              |              |
|                         | Power Supply Input                      |  | 24 VDC±5%  |              |              |              |              |
|                         | Power Consumption                       |  | 6 W  |              |              |              |              |
|                         | Excitation Current                      |  | 0.25 A   |              |              |              |              |
| Weight*2                | Motor lb. (kg)                          |  | 6.6 (3.0) [7.5 (3.4)]  |              |              |              |              |
|                         | Driver lb. (kg)                         |  | 1.8 (0.8)  |              |              |              |              |
| Dimension No.           | Motor                                   |  | □6   |              |              |              |              |
|                         | Driver                                  |  | AS=□13 AS PLUS=□14   |              |              |              |              |

\*1 The square box in the model number will contain one of the following letters to indicate the power supply voltage: **A** (Single-Phase 100-115 VAC), **C** (Single-Phase 200-230 VAC) or **S** (Three-Phase 200-230 VAC).

\*2 The values inside the brackets [ ] represents the specification for electromagnetic brake type.

\*3 The electromagnetic brakes are for holding the position when the power is off. They can not be used for complicated braking.

Also, a separate 24 VDC ±5%, 0.3 A min. power supply is required for the electromagnetic brake, along with the accessory electromagnetic brake type extension cable.

\*4 **AS** series: The resolution can be set to any one of 500 P/R, 1000 P/R, 5000 P/R, 10000 P/R with the resolution select switch or resolution select switching signals. See page C-39 for details.

**AS PLUS:** The resolution can be set from 500 P/R to 10000 P/R by setting parameters.

**How to Read Specifications Table**→Page C-9

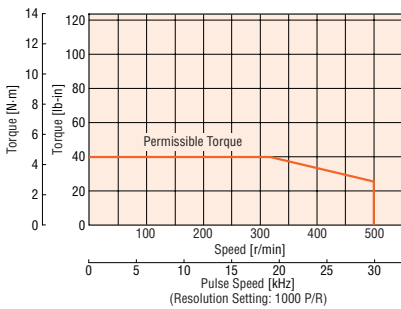
**Note:**

- Direction of rotation of the motor and that of the gear output shaft are the same for unit type with reduction ratio 3.6:1, 7.2:1 and 10:1. It is opposite for 20:1 and 30:1 ratio type.

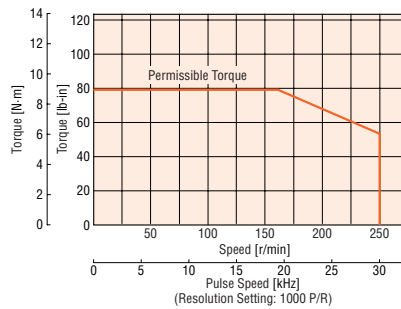
## Speed — Torque Characteristics

How to Read Speed-Torque Characteristics→Page C-10

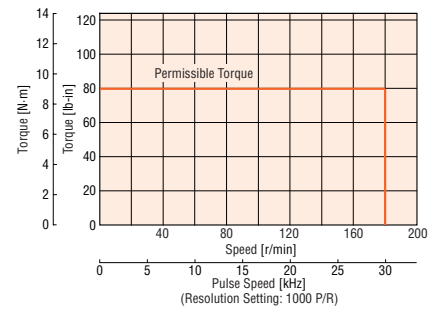
AS98□□-T3.6, AS98□□P-T3.6



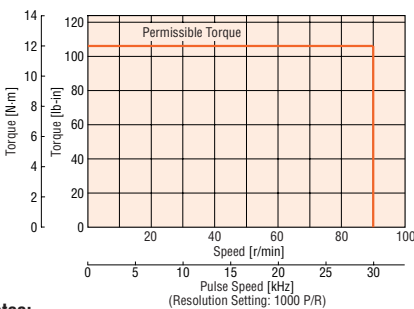
AS98□□-T7.2, AS98□□P-T7.2



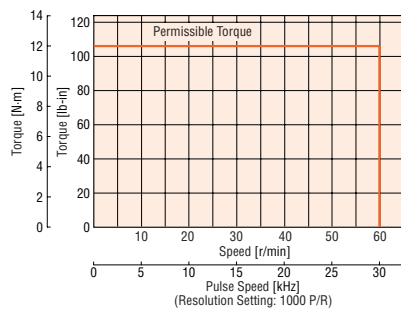
AS98□□-T10, AS98□□P-T10



AS98□□-T20, AS98□□P-T20



AS98□□-T30, AS98□□P-T30



**Notes:**

- Pay attention to heat dissipation from motor and driver. In particular, remember that the motor will produce a considerable amount of heat under certain conditions. Be sure to keep the temperature of the motor case under 212°F (100°C). [Under 176°F (75°C) is required to comply with UL or CSA standards.]
- When using the motor with the dedicated driver, the driver's automatic current cutback at motor standstill function reduces maximum holding torque by approximately 50%.



# PN Geared Type

Motor Frame Size:  1.65 in. ( 42 mm)

## Specifications

\*Only the driver conforms to the CSA standard for **AS46** type motors.



| Model                   | AS                                      |   | AS46AA-N7.2             |              | AS46AA-N10 |   |                  |
|-------------------------|---|---|-------------------------|--------------|------------|---|------------------|
|                         | AS PLUS                                 |   | AS46MA-N7.2             |              | AS46MA-N10 |   |                  |
|                         |   | W/O Electromagnetic Brake                           |                         | AS46AAP-N7.2 |            | AS46AAP-N10   |                  |
|                         |   | Electromagnetic Brake                               |                         | AS46MAP-N7.2 |            | AS46MAP-N10   |                  |
| Maximum Holding Torque  | lb-in (N·m)                             |   |                         |              |            | 13.2 (1.5)  |                  |
| Rotor Inertia*2 J       | oz-in <sup>2</sup> (kg·m <sup>2</sup> ) |   |                         |              |            | 0.37 (68×10 <sup>-7</sup> ) [0.45 (83×10 <sup>-7</sup> )] |                  |
| Backlash                | arc min (degrees)                       |   |                         |              |            | 2 (0.034°)  |                  |
| Angle Error             | arc min (degrees)                       |   |                         |              |            | 6 (0.1°)  |                  |
| Permissible Speed Range | r/min                                   | 0~416   |                         |              |            | 0~300   |                  |
| Gear Ratio              |   | 7.2 : 1   |                         |              |            | 10 : 1  |                  |
| Resolution*4            | 1000 P/R                                | 0.05°/pulse   |                         |              |            | 0.036°/pulse  |                  |
| Permissible Torque      | lb-in (N·m)                             |   |                         |              |            | 13.2 (1.5)  |                  |
| Maximum Torque*5        | lb-in (N·m)                             |   |                         |              |            | 17.7 (2)  |                  |
| Power Source            | Voltage-Frequency-Maximum Input Current | Single-Phase 100-115 VAC -15%~+10% · 50/60 Hz·3.3 A |                         |              |            |   |                  |
| Electromagnetic Brake*3 | Type                                    | Active when power is off                            |                         |              |            |   |                  |
|                         | Power Supply Input                      | 24 VDC±5%   |                         |              |            |   |                  |
|                         | Power Consumption                       | 2 W   |                         |              |            |   |                  |
|                         | Excitation Current                      | 0.08 A  |                         |              |            |   |                  |
| Weight*2                | Motor                                   | lb. (kg)  | 1.6 (0.71) [1.8 (0.81)] |              |            |   |                  |
|                         | Driver                                  | lb. (kg)  | 1.8 (0.8)               |              |            |   |                  |
| Dimension No.           | Motor                                   |   |                         |              |            |   | 7                |
|                         | Driver                                  |   |                         |              |            |   | AS=13 AS PLUS=14 |

\*2 The values inside the brackets [ ] represents the specification for electromagnetic brake type.

\*3 The electromagnetic brakes are for holding the position when the power is off. They can not be used for complicated braking.

Also, a separate 24 VDC ±5%, 0.3 A min. power supply is required for the electromagnetic brake, along with the accessory standard type extension cable.

\*4 **AS** series: The resolution can be set to any one of 500 P/R, 1000 P/R, 5000 P/R, 10000 P/R with the resolution select switch or resolution select switching signals. See page C-39 for details.

**AS PLUS**: The resolution can be set from 500 P/R to 10000 P/R by setting parameters.

\*5 The value of Maximum Torque is for gear. For output torque for geared motor, refer to the Speed - Torque characteristics.

**How to Read Specifications Table**→Page C-9

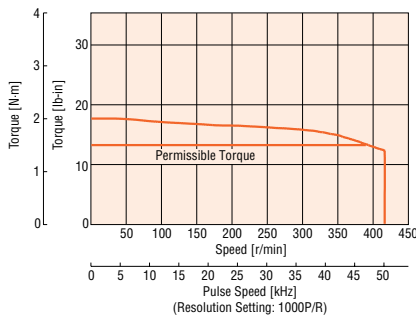
**Note:**

- Direction of rotation of the motor and that of the gear output shaft are the same.

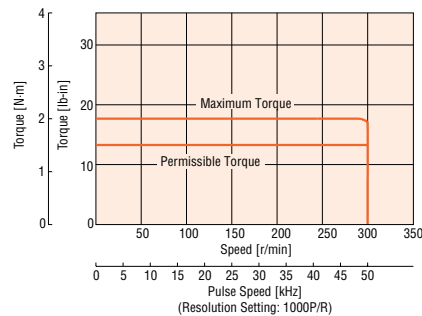
## Speed — Torque Characteristics

How to Read Speed-Torque Characteristics→Page C-10

AS46□A-N7.2, AS46□AP-N7.2



AS46□A-N10, AS46□AP-N10



**Notes:**

- Pay attention to heat dissipation from motor and driver. In particular, remember that the motor will produce a considerable amount of heat under certain conditions. Be sure to keep the temperature of the motor case under 212°F (100°C). [Under 176°F (75°C) is required to comply with UL or CSA standards.]
- When using the motor with the dedicated driver, the driver's automatic current cutback at motor standstill function reduces maximum holding torque by approximately 50%.

Introduction

AS

AS PLUS

AS

AS PLUS

ASC

DC Input

AC Input

RK

DC Input

CRK II

DC Input

CSK

DC Input

PMC

DC Input

UMK

DC Input

CSK

DC Input

PK/PV

Encoder

PK

with Encoder

PK

with Indexer

UI2120G

EMP401

EMP402

SG8030J

Controllers

SMK

Low-Speed Synchronous Motors

Accessories

Before Using a Stepping Motor



# PN Geared Type

Motor Frame Size: □ 2.36 in. (□ 60 mm)



## Specifications

| Model*1                 | AS                                      |  | AS66A□-N5  | AS66A□-N7.2 | AS66A□-N10   | AS66A□-N25             | AS66A□-N36  | AS66A□-N50    |
|-------------------------|---|--|--|-------------|--------------|------------------------|-------------|---------------|
|                         | AS PLUS                                 |  | AS66M□-N5  | AS66M□-N7.2 | AS66M□-N10   | AS66M□-N25             | AS66M□-N36  | AS66M□-N50    |
| Maximum Holding Torque  | lb-in (N·m)                             |  | 30 (3.5)   | 35 (4.0)    | 44 (5.0)     |                        | 70 (8.0)    |               |
| Rotor Inertia*2 J       | oz-in <sup>2</sup> (kg·m <sup>2</sup> ) |  | 2.2 (405×10 <sup>-7</sup> ) [3.1 (564×10 <sup>-7</sup> )]  |             |              |                        |             |               |
| Backlash                | arc min (degrees)                       |  | 2 (0.034°)   |             |              | 3 (0.05°)              |             |               |
| Angle Error             | arc min (degrees)                       |  | 5 (0.084°)   |             |              |                        |             |               |
| Permissible Speed Range | r/min                                   |  | 0~600  | 0~416       | 0~300        | 0~120                  | 0~83        | 0~60          |
| Gear Ratio              |   |  | 5 : 1  | 7.2 : 1     | 10 : 1       | 25 : 1                 | 36 : 1      | 50 : 1        |
| Resolution*4            | 1000 P/R                                |  | 0.072°/pulse   | 0.05°/pulse | 0.036°/pulse | 0.0144°/pulse          | 0.01°/pulse | 0.0072°/pulse |
| Permissible Torque      | lb-in (N·m)                             |  | 30 (3.5)   | 35 (4.0)    | 44 (5.0)     | 70 (8.0)               |             |               |
| Maximum Torque*5        | lb-in (N·m)                             |  | 61 (7)   | 79 (9)      | 97 (11)      | 141 (16)               | 177 (20)    | 177 (20)      |
| Power Source            | Voltage-Frequency-Maximum Input Current |  | <input type="checkbox"/> =A for Single-Phase 100-115 VAC -15%~+10% · 50/60 Hz-5.0 A<br><input type="checkbox"/> =C for Single-Phase 200-230 VAC -15%~+10% · 50/60 Hz-3.0 A<br><input type="checkbox"/> =S for Three-Phase 200-230 VAC -15%~+10% · 50/60 Hz-1.5 A |             |              |                        |             |               |
| Electromagnetic Brake*3 | Type                                    |  | Active when power is off   |             |              |                        |             |               |
|                         | Power Supply Input                      |  | 24 VDC±5%  |             |              |                        |             |               |
|                         | Power Consumption                       |  | 6 W  |             |              |                        |             |               |
|                         | Excitation Current                      |  | 0.25 A   |             |              |                        |             |               |
| Weight*2                | Motor lb. (kg)                          |  | 3.3 (1.5) [3.9 (1.75)]   |             |              | 3.7 (1.7) [4.3 (1.95)] |             |               |
|                         | Driver lb. (kg)                         |  | 1.8 (0.8)  |             |              |                        |             |               |
| Dimension No.           | Motor                                   |  | 8  |             |              |                        |             |               |
|                         | Driver                                  |  | AS=13 AS PLUS=14   |             |              |                        |             |               |

\*1 The square box in the model number will contain one of the following letters to indicate the power supply voltage: **A** (Single-Phase 100-115 VAC), **C** (Single-Phase 200-230 VAC) or **S** (Three-Phase 200-230 VAC).

\*2 The values inside the brackets [ ] represents the specification for electromagnetic brake type.

\*3 The electromagnetic brakes are for holding the position when the power is off. They can not be used for complicated braking.

Also, a separate 24 VDC ±5%, 0.3 A min. power supply is required for the electromagnetic brake, along with the accessory electromagnetic brake type extension cable.

\*4 **AS** series: The resolution can be set to any one of 500 P/R, 1000 P/R, 5000 P/R, 10000 P/R with the resolution select switch or resolution select switching signals. See page C-39 for details.

**AS PLUS**: The resolution can be set from 500 P/R to 10000 P/R by setting parameters.

\*5 The value of Maximum Torque is for gear. For output torque for geared motor, refer to the Speed - Torque characteristics.

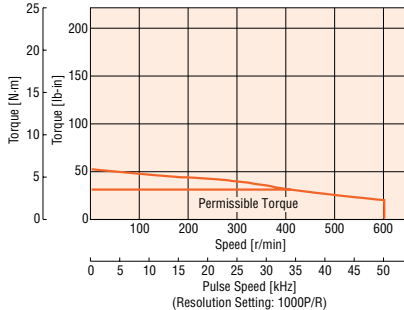
**How to Read Specifications Table**→Page C-9

**Note:** Direction of rotation of the motor and that of the gear output shaft are the same.

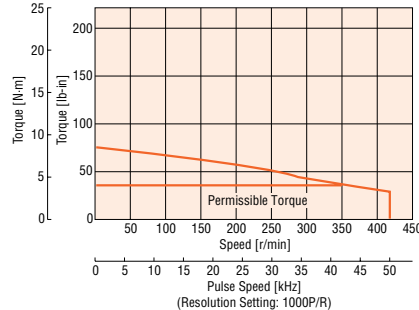
## Speed — Torque Characteristics

How to Read Speed-Torque Characteristics→Page C-10

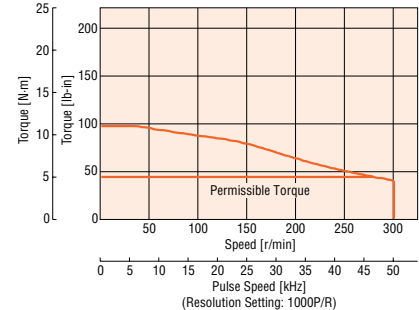
AS66□-N5, AS66□P-N5



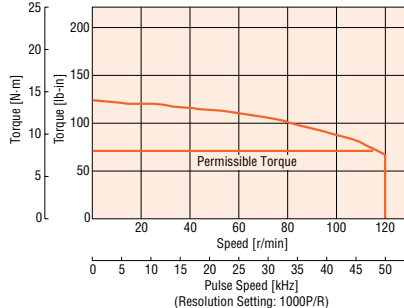
AS66□-N7.2, AS66□P-N7.2



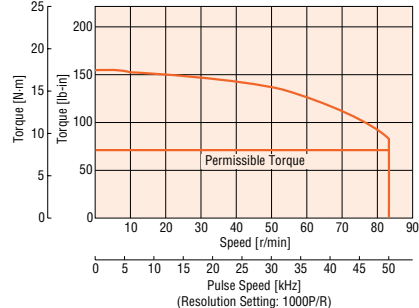
AS66□-N10, AS66□P-N10



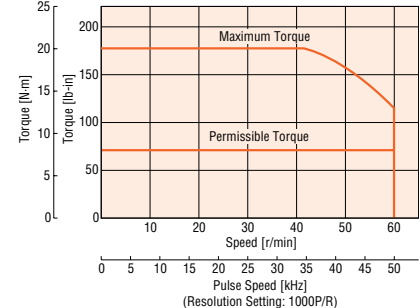
AS66□-N25, AS66□P-N25



AS66□-N36, AS66□P-N36



AS66□-N50, AS66□P-N50



### Notes:

- Pay attention to heat dissipation from motor and driver. In particular, remember that the motor will produce a considerable amount of heat under certain conditions. Be sure to keep the temperature of the motor case under 212°F (100°C). [Under 176°F (75°C) is required to comply with UL or CSA standards.]
- When using the motor with the dedicated driver, the driver's automatic current cutback at motor standstill function reduces maximum holding torque by approximately 50%.

# PN Geared Type

Motor Frame Size:  3.54 in. ( 90 mm)



## Specifications

| Model*1                 | AS                                      |  | AS98A□-N5  | AS98A□-N7.2   | AS98A□-N10   | AS98A□-N25          | AS98A□-N36   | AS98A□-N50    |
|-------------------------|---|--|--|---------------|--------------|---------------------|--------------|---------------|
|                         | W/O Electromagnetic Brake               |  | AS98M□-N5  | AS98M□-N7.2   | AS98M□-N10   | AS98M□-N25          | AS98M□-N36   | AS98M□-N50    |
| AS PLUS                 | W/O Electromagnetic Brake               |  | AS98A□-P-N5  | AS98A□-P-N7.2 | AS98A□-P-N10 | AS98A□-P-N25        | AS98A□-P-N36 | AS98A□-P-N50  |
|                         | Electromagnetic Brake                   |  | AS98M□-P-N5  | AS98M□-P-N7.2 | AS98M□-P-N10 | AS98M□-P-N25        | AS98M□-P-N36 | AS98M□-P-N50  |
| Maximum Holding Torque  | lb-in (N·m)                             |  | 88 (10)  | 123 (14)      | 177 (20)     | 320 (37)            |              |               |
| Rotor Inertia*2 J       | oz-in <sup>2</sup> (kg·m <sup>2</sup> ) |  | 7.7 (1400×10 <sup>-7</sup> ) [8.5 (1560×10 <sup>-7</sup> )]  |               |              |                     |              |               |
| Backlash                | arc min (degrees)                       |  | 2 (0.034°)   |               |              | 3 (0.05°)           |              |               |
| Angle Error             | arc min (degrees)                       |  | 4 (0.067°)   |               |              |                     |              |               |
| Permissible Speed Range | r/min                                   |  | 0~600  | 0~416         | 0~300        | 0~120               | 0~83         | 0~60          |
| Gear Ratio              |   |  | 5 : 1  | 7.2 : 1       | 10 : 1       | 25 : 1              | 36 : 1       | 50 : 1        |
| Resolution*4            | 1000 P/R                                |  | 0.072°/pulse   | 0.05°/pulse   | 0.036°/pulse | 0.0144°/pulse       | 0.01°/pulse  | 0.0072°/pulse |
| Permissible Torque      | lb-in (N·m)                             |  | 88 (10)  | 123 (14)      | 177 (20)     | 320 (37)            |              |               |
| Maximum Torque*5        | lb-in (N·m)                             |  | 240 (28)   | 300 (35)      | 300 (35)     | 490 (56)            | 530 (60)     | 530 (60)      |
| Power Source            | Voltage-Frequency-Maximum Input Current |  | <input type="checkbox"/> = <b>A</b> for Single-Phase 100-115 VAC -15%~+10% · 50/60 Hz·6.0 A<br><input type="checkbox"/> = <b>C</b> for Single-Phase 200-230 VAC -15%~+10% · 50/60 Hz·3.5 A<br><input type="checkbox"/> = <b>S</b> for Three-Phase 200-230 VAC -15%~+10% · 50/60 Hz·1.9 A |               |              |                     |              |               |
| Electromagnetic Brake*3 | Type                                    |  | Active when power is off   |               |              |                     |              |               |
|                         | Power Supply Input                      |  | 24 VDC±5%  |               |              |                     |              |               |
|                         | Power Consumption                       |  | 6 W  |               |              |                     |              |               |
|                         | Excitation Current                      |  | 0.25 A   |               |              |                     |              |               |
| Weight*2                | Static Friction Torque lb-in (N·m)      |  | 39 (4.5)   | 57 (6.45)     | 79 (9)       | 163 (18.5)          |              |               |
|                         | Motor lb. (kg)                          |  | 8.8 (4.0) [9.7 (4.4)]  |               |              | 10 (4.7) [11 (5.1)] |              |               |
|                         | Driver lb. (kg)                         |  | 1.8 (0.8)  |               |              |                     |              |               |
| Dimension No.           | Motor                                   |  | 9  |               |              |                     |              |               |
|                         | Driver                                  |  | <b>AS</b> = 13 <b>AS PLUS</b> = 14   |               |              |                     |              |               |

\*1 The square box in the model number will contain one of the following letters to indicate the power supply voltage: **A** (Single-Phase 100-115 VAC), **C** (Single-Phase 200-230 VAC) or **S** (Three-Phase 200-230 VAC).

\*2 The values inside the brackets [ ] represents the specification for electromagnetic brake type.

\*3 The electromagnetic brakes are for holding the position when the power is off. They can not be used for complicated braking.

Also, a separate 24 VDC ±5%, 0.3 A min. power supply is required for the electromagnetic brake, along with the accessory electromagnetic brake type extension cable.

\*4 **AS** series: The resolution can be set to any one of 500 P/R, 1000 P/R, 5000 P/R, 10000 P/R with the resolution select switch or resolution select switching signals. See page C-39 for details.

**AS PLUS**: The resolution can be set from 500 P/R to 10000 P/R by setting parameters.

\*5 The value of Maximum Torque is for gear. For output torque for geared motor, refer to the Speed - Torque characteristics.

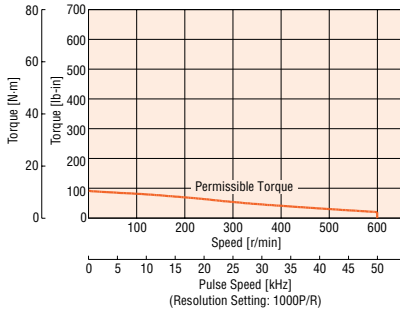
**How to Read Specifications Table** → Page C-9

**Note:** Direction of rotation of the motor and that of the gear output shaft are the same.

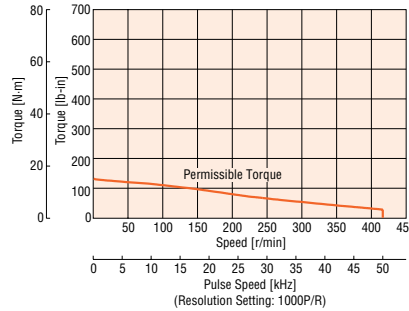
## Speed — Torque Characteristics

How to Read Speed-Torque Characteristics → Page C-10

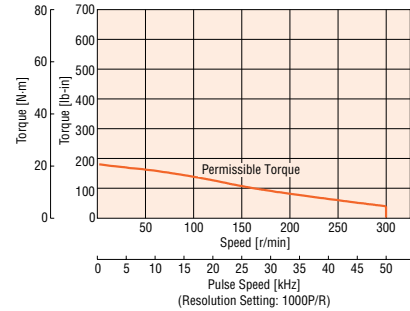
**AS98□-N5, AS98□-P-N5**



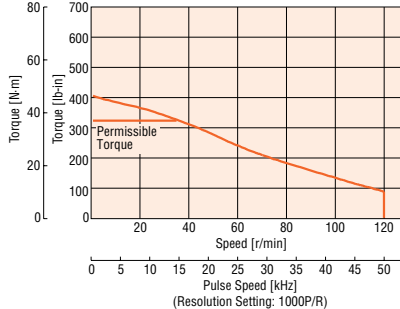
**AS98□-N7.2, AS98□-P-N7.2**



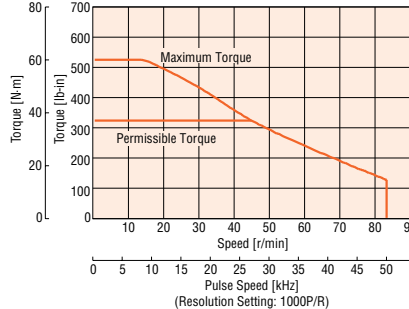
**AS98□-N10, AS98□-P-N10**



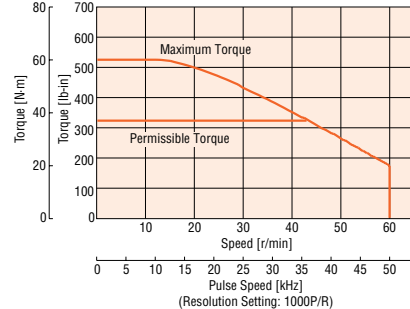
**AS98□-N25, AS98□-P-N25**



**AS98□-N36, AS98□-P-N36**



**AS98□-N50, AS98□-P-N50**



### Notes:

- Pay attention to heat dissipation from motor and driver. In particular, remember that the motor will produce a considerable amount of heat under certain conditions. Be sure to keep the temperature of the motor case under 212°F (100°C). [Under 176°F (75°C) is required to comply with UL or CSA standards.]
- When using the motor with the dedicated driver, the driver's automatic current cutback at motor standstill function reduces maximum holding torque by approximately 50%.

# HG Geared Type

Motor Frame Size: □ 1.65 in. (□ 42 mm), □ 2.36 in. (□ 60 mm), □ 3.54 in. (□ 90 mm)



## Specifications

\*Only the driver conforms to the CSA standard for AS46 type motors.

| Model*1                   | AS                                      |                           | AS46AA2-H50  | AS46AA2-H100                 | AS66A□2-H50  | AS66A□2-H100                | AS98A□-H50   | AS98A□-H100                  |              |
|---------------------------|---|---------------------------|--|------------------------------|--|-----------------------------|--|------------------------------|--------------|
|                           | AS PLUS                                 |                           | AS46MA2-H50  | AS46MA2-H100                 | AS66M□2-H50  | AS66M□2-H100                | AS98M□-H50   | AS98M□-H100                  |              |
|                           |   | W/O Electromagnetic Brake |  | AS46AAP2-H50                 | AS46AAP2-H100  | AS66A□P2-H50                | AS66A□P2-H100  | AS98A□P-H50                  | AS98A□P-H100 |
|                           |   | Electromagnetic Brake     |  | AS46MAP2-H50                 | AS46MAP2-H100  | AS66M□P2-H50                | AS66M□P2-H100  | AS98M□P-H50                  | AS98M□P-H100 |
| Maximum Holding Torque    | lb-in (N·m)                             |                           | 30 (3.5)   | 44 (5.0)                     | 48 (5.5)   | 70 (8.0)                    | 220 (25)   | 320 (37)                     |              |
| Rotor Inertia*2 J         | oz-in <sup>2</sup> (kg·m <sup>2</sup> ) |                           | 0.46 (85×10 <sup>-7</sup> )                          | 0.55 (100×10 <sup>-7</sup> ) | 2.4 (440×10 <sup>-7</sup> )  | 3.3 (599×10 <sup>-7</sup> ) | 8.8 (1600×10 <sup>-7</sup> )   | 9.6 (1759×10 <sup>-7</sup> ) |              |
| Permissible Speed Range   | r/min                                   |                           | 0~70   | 0~35                         | 0~70   | 0~35                        | 0~70   | 0~35                         |              |
| Gear Ratio                |   |                           | 50 : 1   | 100 : 1                      | 50 : 1   | 100 : 1                     | 50 : 1   | 100 : 1                      |              |
| Resolution*4              | 1000 P/R                                |                           | 0.0072°/pulse  | 0.0036°/pulse                | 0.0072°/pulse  | 0.0036°/pulse               | 0.0072°/pulse  | 0.0036°/pulse                |              |
| Permissible Torque        | lb-in (N·m)                             |                           | 30 (3.5)   | 44 (5.0)                     | 48 (5.5)   | 70 (8.0)                    | 220 (25)   | 320 (37)                     |              |
| Maximum Torque            | lb-in (N·m)                             |                           | 73 (8.3)   | 97 (11)                      | 159 (18)   | 240 (28)                    | 300 (35)   | 480 (55)                     |              |
| Lost Motion (Load Torque) | arc min                                 |                           | Max. 1.5 (±0.16 N·m)                                 | Max. 1.5 (±0.2 N·m)          | Max. 0.7 (±0.28 N·m)   | Max. 0.7 (±0.39 N·m)        | Max. 1.5 (±1.2 N·m)  | Max. 1.5 (±1.2 N·m)          |              |
| Power Source              | Voltage-Frequency-Maximum Input Current |                           | Single-Phase 100-115 VAC<br>-15%~+10%-50/60 Hz 3.3 A |                              | Single-Phase 100-115 VAC -15%~+10%-50/60 Hz 5 A<br>Single-Phase 200-230 VAC -15%~+10%-50/60 Hz 3 A<br>Three-Phase 200-230 VAC -15%~+10%-50/60 Hz 1.5 A |                             | Single-Phase 100-115 VAC -15%~+10%-50/60 Hz 6 A<br>Single-Phase 200-230 VAC -15%~+10%-50/60 Hz 3.5 A<br>Three-Phase 200-230 VAC -15%~+10%-50/60 Hz 1.9 A |                              |              |
| Electromagnetic Brake*3   | Type                                    |                           | Active when power is off                             |                              |  |                             |  |                              |              |
|                           | Power Supply Input                      |                           | 24 VDC±5%  |                              |  |                             |  |                              |              |
|                           | Power Consumption                       |                           | 2 W  |                              | 6 W  |                             | 6 W  |                              |              |
|                           | Excitation Current                      |                           | 0.08 A   |                              | 0.25 A   |                             | 0.25 A   |                              |              |
| Weight*2                  | Static Friction Torque lb-in (N·m)      |                           | 15.4 (1.75)  | 22 (2.5)                     | 24 (2.75)  | 35 (4)                      | 110 (12.5)   | 163 (18.5)                   |              |
|                           | Motor lb. (kg)                          |                           | 1.5 (0.7) [1.8 (0.8)]                                |                              | 3.1 (1.4) [3.6 (1.65)]   |                             | 8.6 (3.9) [9.5 (4.3)]  |                              |              |
| Dimension No.             | Driver                                  |                           | □10  |                              | □11  |                             | □12  |                              |              |
|                           |   |                           | AS=□13 AS PLUS=□14                                   |                              |  |                             |  |                              |              |

\*1 The square box in the model number will contain one of the following letters to indicate the power supply voltage: **A** (Single-Phase 100-115 VAC), **C** (Single-Phase 200-230 VAC) or **S** (Three-Phase 200-230 VAC).

\*2 The values inside the brackets [ ] represents the specification for electromagnetic brake type.

\*3 The electromagnetic brakes are for holding the position when the power is off. They can not be used for complicated braking.

Also, a separate 24 VDC ±5%, 0.3 A min. power supply is required for the electromagnetic brake, along with the accessory electromagnetic brake type extension cable. For motor frame size □1.65 in. (□42 mm), use the standard type extension cable.

\*4 **AS** series: The resolution can be set to any one of 500 P/R, 1000 P/R, 5000 P/R, 10000 P/R with the resolution select switch or resolution select switching signals. See page C-39 for details.

**AS PLUS:** The resolution can be set from 500 P/R to 10000 P/R by setting parameters.

**How to Read Specifications Table** → Page C-9

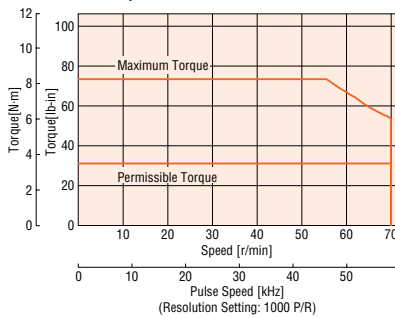
### Note:

- The inertia represents a sum of the inertia at the harmonic gear converted to a motor shaft value, and the rotor inertia. Direction of rotation of the motor and that of the gear output shaft are the opposite.

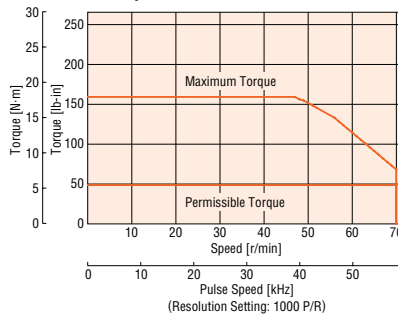
## Speed — Torque Characteristics

How to Read Speed-Torque Characteristics → Page C-10

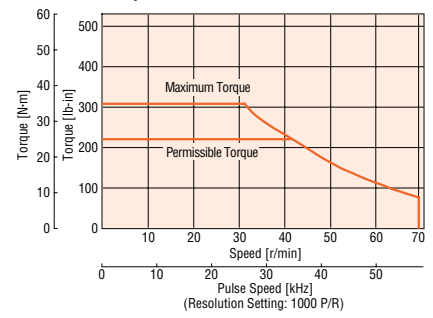
AS46□A2-H50, AS46□AP2-H50



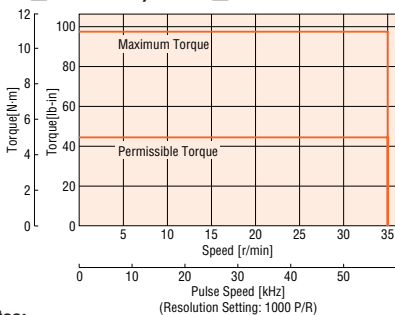
AS66□□2-H50, AS66□□P2-H50



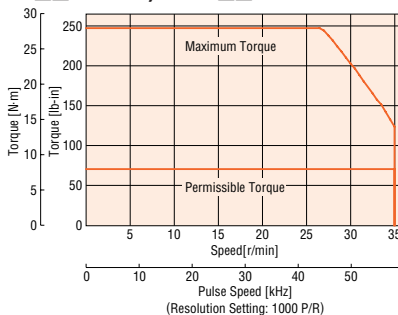
AS98□□-H50, AS98□□P-H50



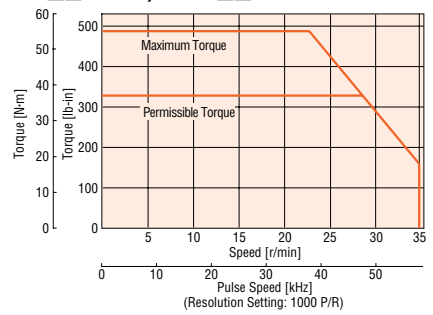
AS46□A2-H100, AS46□AP2-H100



AS66□□2-H100, AS66□□P2-H100



AS98□□-H100, AS98□□P-H100



### Notes:

- Pay attention to heat dissipation from motor and driver. In particular, remember that the motor will produce a considerable amount of heat under certain conditions. Be sure to keep the temperature of the motor case under 212°F(100°C). [Under 176°F(75°C) is required to comply with UL or CSA standards.]
- In order to prevent fatigue of the gear grease in the harmonic gear, keep the temperature of the gear case under 158°F (70°C).
- When using the motor with the dedicated driver, the driver's automatic current cutback at motor standstill function reduces maximum holding torque by approximately 50%.

## Common Specifications

### AS Series

|                                    |   |
|------------------------------------|---|
| Speed and Position Control Command | Pulse Train Input   |
| Maximum Input Pulse Frequency      | 250 kHz (When the pulse duty is 50%)  |
| Protective Functions               | Overheat, Overload, Overvoltage, Speed Error, Overcurrent, OverSpeed, EEPROM Data Error, Sensor Error, System Error   |
| Input Signals                      | Photocoupler Input (optically isolated), Equivalent Input Impedance : 220 Ω, Input Current 7~20 mA<br>[Pulse Signal (Negative logic pulse input), Rotation Direction Signal, All Windings Off Signal, Alarm Clear Signal, Resolution Select Signal]                 |
| Output Signals                     | Photocoupler, Open-Collector Output, External use condition: 30 VDC maximum, 15 mA Maximum<br>(Positioning Completion Signal, Alarm Signal, Excitation Timing Signal, ASG•BSG Signal)<br>Line Driver Output: Equivalent of 26C31<br>(Timing Signal, ASG•BSG Signal) |

### AS PLUS

|                                  |   |
|----------------------------------|---|
| Positioning Control              | Incremental (relative distance) mode/Absolute (absolute positioning) mode.<br>One-shot operation/Linked operation (A maximum of 4 profiles can be linked)<br>Maximum Operating Ranges<br>• Steps: -8388608~8388607 (1 each) • Operating speed: 10 Hz~500,000 Hz (500 kHz) • Acceleration/deceleration rate*: 10~50,000 msec |
| Operating Modes                  | • Indexing (Positioning operation) • Scan (Continuous operation) • Linked Profile<br>• Return (Return to electrical home position) • Home Operation (Return to mechanical home position)  |
| Mechanical Home Hunting Function | Home hunting operation is performed from the entire range using mechanical position detection signals (+LS, -LS, HOMELS).   |
| Other Functions                  | • Setting function for speed-filter value • Current setting function • Electronic gear function<br>• Setting function for direction of motor rotation • Emergency stop function • Over-travel function<br>• Software over-travel function • Alarm trace-back function • Daisy-chain connections                             |
| Input Signals                    | AC Photocoupler input<br>Control inputs: 24 VDC, input resistance 4.7 kΩ (X0~X7, START, E-STOP, HOMELS, +LS, -LS, SENSOR)   |
| Output Signals                   | Photocoupler/Open Collector Output External operating conditions; 30 VDC or below, 4~8 mA (Y0~Y7, ALM)  |
| Terminal Emulation               | Communication Standard: RS-232C conformity Transmit system: Asynchronous communication, NRZ (Non Return to Zero), Full duplex<br>Data length: 8 bits, 1 stop bit, No parity Transmit speed: 9600 bps<br>Connector specification: Modular (4 wires, 4 pins)<br>Pin arrangement: RS232 Compatible Protocol: TTY (CR+LF)       |
| User Program                     | Maximum number of programs: 14 programs (including STARTUP program) Maximum lines per program: 64 lines<br>Maximum commands per 1 line: 1 command (Single state) Maximum program variables: 26 variables (A~Z)  |

\* The rates of acceleration and deceleration can be set separately.

## General Specifications

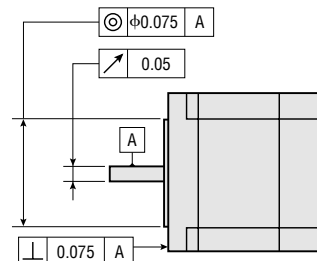
This is the value after rated operation at normal temperature and normal humidity.

|                                      |                     | Motor   | Driver   |
|--------------------------------------|---------------------|---|--|
| Insulation Class                     |                     | Class B [266°F (130°C)] [UL/CSA: Recognized as class A 221°F(105°C)]  | —  |
| Insulation Resistance                |                     | 100 MΩ minimum when measured by a 500 VDC megger between the following places:<br>• Frame-Windings • Frame-Electromagnetic brake windings                               | 100 MΩ minimum when measured by a 500 VDC megger between the following places:<br>• Frame-Power supply input terminal • I/O-Power supply input terminal  |
| Dielectric Strength                  |                     | Sufficient to withstand the following for one minute:<br>• Frame-Windings 1.5 kV (1.0 kV for <b>AS46</b> ) 50 Hz<br>• Frame-Electromagnetic brake windings 1.0 kV 50 Hz | Sufficient to withstand the following for one minute:<br>• Frame-Power supply input terminal 1.5 kV 50 Hz<br>• I/O-Power supply input terminal 2.3 kV (3.0 kV for 200-230 VAC) 50 Hz: <b>AS</b> 1.8 kV 50 Hz: <b>AS PLUS</b> |
| Operating Environment (In Operation) | Ambient Temperature | 0°C~+50°C (32°F~122°F), nonfreezing   | <b>AS PLUS</b> : 0°C~+40°C (32°F~104°F)<br><b>AS</b> : 0°C~+50°C (32°F~122°F), nonfreezing   |
|                                      | Ambient Humidity    | 85% or less (noncondensing)   |  |
|                                      | Atmosphere          | No corrosive gases, dust, water or oil.   |  |
| Static Angle Error                   |                     | ±5 minutes  | —  |
| Shaft Runout                         |                     | 0.002 inch (0.05 mm) T.I.R.*  | —  |
| Concentricity                        |                     | 0.003 inch (0.075 mm) T.I.R.*   | —  |
| Perpendicularity                     |                     | 0.003 inch (0.075 mm) T.I.R.*   | —  |

\* T.I.R.(Total Indicator Reading) : Refers to the total dial gauge reading when the measurement section is rotated 1 revolution centered on the reference axis center.

#### Note:

- Do not measure insulation resistance or perform the dielectric strength test while the motor and driver are connected.



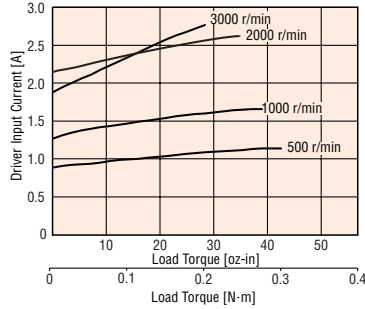
## Load Torque — Driver Input Current Characteristics

This is the relationship between the load torque and driver input current at each speed when the motor is operated. From these characteristics, the current capacity required when used for multiple axes can be estimated. For the Geared Type, calculate the power capacity in terms of the speed and the torque at the motor shaft.

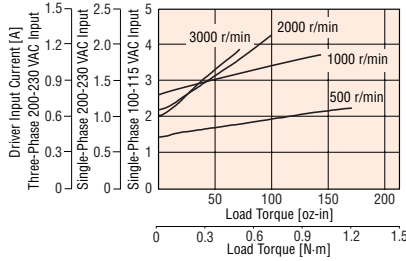
Motor shaft speed = Gear output shaft speed × Gear ratio [r/min]

Motor shaft torque =  $\frac{\text{Gear output shaft torque}}{\text{Gear ratio}}$  [oz-in (N·m)]

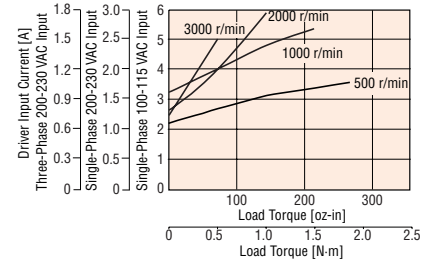
**AS46□A, AS46□AP**



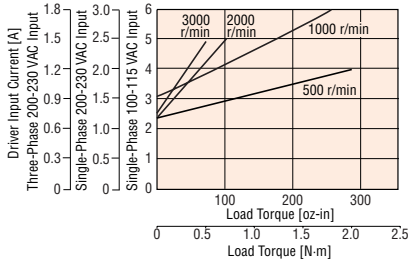
**AS66□□, AS66□□P**



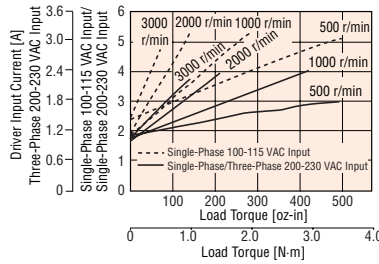
**AS69□□, AS69□□P**



**AS98□□, AS98□□P**



**AS911A□□, AS911A□□P**



## Permissible Overhung Load and Permissible Thrust Load

Unit = Upper values: lb./Lower values: N

| Model                      | Overhung Load<br>Distance from Shaft End [inch (mm)] |             |             |             |             | Thrust Load   |
|----------------------------|--|-------------|-------------|-------------|-------------|---|
|                            | 0  | 0.2 (5)     | 0.39 (10)   | 0.59 (15)   | 0.79 (20)   |   |
| <b>AS46</b> □              | 4.5<br>20  | 5.6<br>25   | 7.6<br>34   | 11.7<br>52  | —           | Keep thrust loads below the weight of the motor used. |
| <b>AS66</b> □              | 14.1   | 16.8        | 21          | 29          | 42          |   |
| <b>AS69</b> □              | 63   | 75          | 95          | 130         | 190         |   |
| <b>AS98</b> □              | 58   | 65          | 76          | 87          | 108         |   |
| <b>AS911A</b> □            | 260  | 290         | 340         | 390         | 480         |   |
| <b>AS46</b> □- <b>T3.6</b> | 2.2<br>10  | 3.1<br>14   | 4.5<br>20   | 6.7<br>30   | —           | 3.3<br>15   |
| <b>AS46</b> □- <b>T7.2</b> |  |             |             |             |             |   |
| <b>AS46</b> □- <b>T10</b>  |  |             |             |             |             |   |
| <b>AS46</b> □- <b>T20</b>  |  |             |             |             |             |   |
| <b>AS46</b> □- <b>T30</b>  |  |             |             |             |             |   |
| <b>AS66</b> □- <b>T3.6</b> | 15.7<br>70   | 18<br>80    | 22<br>100   | 27<br>120   | 33<br>150   | 9<br>40   |
| <b>AS66</b> □- <b>T7.2</b> |  |             |             |             |             |   |
| <b>AS66</b> □- <b>T10</b>  |  |             |             |             |             |   |
| <b>AS66</b> □- <b>T20</b>  |  |             |             |             |             |   |
| <b>AS66</b> □- <b>T30</b>  |  |             |             |             |             |   |
| <b>AS98</b> □- <b>T3.6</b> | 49<br>220  | 56<br>250   | 67<br>300   | 78<br>350   | 90<br>400   |   |
| <b>AS98</b> □- <b>T7.2</b> |  |             |             |             |             |   |
| <b>AS98</b> □- <b>T10</b>  |  |             |             |             |             |   |
| <b>AS98</b> □- <b>T20</b>  |  |             |             |             |             |   |
| <b>AS98</b> □- <b>T30</b>  |  |             |             |             |             |   |
| <b>AS46</b> □- <b>N7.2</b> | 22<br>100  | 27<br>120   | 33<br>150   | 42<br>190   | —           | 22<br>100   |
| <b>AS46</b> □- <b>N10</b>  |  |             |             |             |             |   |
| <b>AS66</b> □- <b>N5</b>   |  |             |             |             |             |   |
| <b>AS66</b> □- <b>N7.2</b> |  |             |             |             |             |   |
| <b>AS66</b> □- <b>N10</b>  |  |             |             |             |             |   |
| <b>AS66</b> □- <b>N25</b>  | 74<br>330  | 81<br>360   | 90<br>400   | 101<br>450  | 117<br>520  |   |
| <b>AS66</b> □- <b>N36</b>  |  |             |             |             |             |   |
| <b>AS66</b> □- <b>N50</b>  |  |             |             |             |             |   |
| <b>AS98</b> □- <b>N5</b>   |  |             |             |             |             |   |
| <b>AS98</b> □- <b>N7.2</b> |  |             |             |             |             |   |
| <b>AS98</b> □- <b>N10</b>  | 108<br>480   | 117<br>520  | 123<br>550  | 130<br>580  | 139<br>620  |   |
| <b>AS98</b> □- <b>N25</b>  |  |             |             |             |             |   |
| <b>AS98</b> □- <b>N36</b>  |  |             |             |             |             |   |
| <b>AS98</b> □- <b>N50</b>  |  |             |             |             |             |   |
| <b>AS98</b> □- <b>N7.2</b> |  |             |             |             |             |   |
| <b>AS98</b> □- <b>N10</b>  | 108<br>480   | 121<br>540  | 135<br>600  | 153<br>680  | 177<br>790  | 67<br>300   |
| <b>AS98</b> □- <b>N25</b>  |  |             |             |             |             |   |
| <b>AS98</b> □- <b>N36</b>  |  |             |             |             |             |   |
| <b>AS98</b> □- <b>N50</b>  |  |             |             |             |             |   |
| <b>AS98</b> □- <b>N7.2</b> |  |             |             |             |             |   |
| <b>AS98</b> □- <b>N10</b>  | 191<br>850   | 210<br>940  | 230<br>1050 | 240<br>1110 | 260<br>1190 |   |
| <b>AS98</b> □- <b>N25</b>  |  |             |             |             |             |   |
| <b>AS98</b> □- <b>N36</b>  |  |             |             |             |             |   |
| <b>AS98</b> □- <b>N50</b>  |  |             |             |             |             |   |
| <b>AS98</b> □- <b>N7.2</b> |  |             |             |             |             |   |
| <b>AS98</b> □- <b>N10</b>  | 200<br>930   | 230<br>1030 | 250<br>1150 | 270<br>1220 | 290<br>1300 |   |
| <b>AS98</b> □- <b>N25</b>  |  |             |             |             |             |   |
| <b>AS98</b> □- <b>N36</b>  |  |             |             |             |             |   |
| <b>AS98</b> □- <b>N50</b>  |  |             |             |             |             |   |
| <b>AS98</b> □- <b>N7.2</b> |  |             |             |             |             |   |
| <b>AS98</b> □- <b>N10</b>  | 230<br>1050  | 260<br>1160 | 290<br>1300 | 310<br>1380 | 330<br>1490 |   |
| <b>AS98</b> □- <b>N25</b>  |  |             |             |             |             |   |
| <b>AS98</b> □- <b>N36</b>  |  |             |             |             |             |   |
| <b>AS98</b> □- <b>N50</b>  |  |             |             |             |             |   |
| <b>AS98</b> □- <b>N7.2</b> |  |             |             |             |             |   |
| <b>AS98</b> □- <b>N10</b>  | 40<br>180  | 49<br>220   | 60<br>270   | 81<br>360   | 114<br>510  | 49<br>220   |
| <b>AS46</b> □- <b>H50</b>  |  |             |             |             |             |   |
| <b>AS46</b> □- <b>H100</b> |  |             |             |             |             |   |
| <b>AS66</b> □- <b>H50</b>  |  |             |             |             |             |   |
| <b>AS66</b> □- <b>H100</b> |  |             |             |             |             |   |
| <b>AS66</b> □- <b>H50</b>  | 72<br>320  | 83<br>370   | 99<br>440   | 123<br>550  | 162<br>720  | 101<br>450  |
| <b>AS66</b> □- <b>H100</b> |  |             |             |             |             |   |
| <b>AS98</b> □- <b>H50</b>  |  |             |             |             |             |   |
| <b>AS98</b> □- <b>H50</b>  |  |             |             |             |             |   |
| <b>AS98</b> □- <b>H100</b> |  |             |             |             |             |   |
| <b>AS98</b> □- <b>H50</b>  | 240<br>1090  | 250<br>1150 | 270<br>1230 | 290<br>1310 | 310<br>1410 | 290<br>1300   |
| <b>AS98</b> □- <b>H100</b> |  |             |             |             |             |   |
| <b>AS98</b> □- <b>H50</b>  |  |             |             |             |             |   |
| <b>AS98</b> □- <b>H100</b> |  |             |             |             |             |   |
| <b>AS98</b> □- <b>H50</b>  |  |             |             |             |             |   |

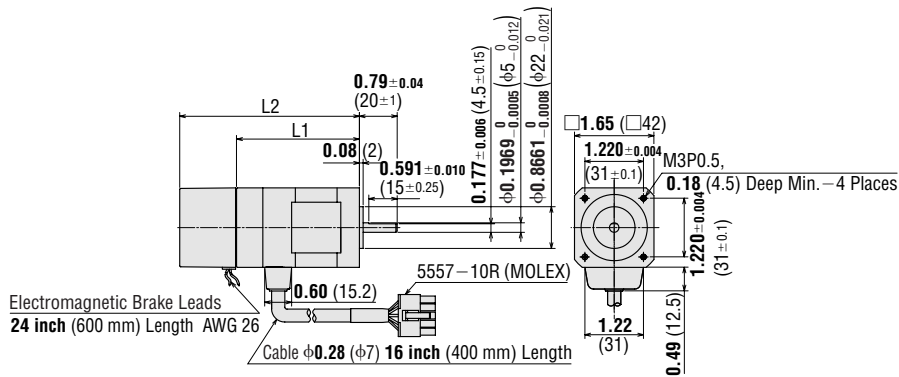
\* These values are common to the **AS** Series, the **AS PLUS** Series and all electromagnetic brake models.

## ■ Dimensions Scale 1/4, Unit = inch (mm)

### ● Motor

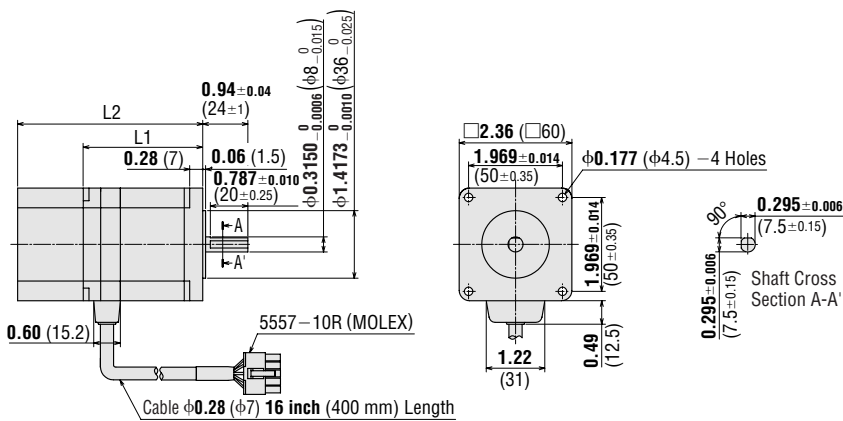
### ◆ Standard Type

1 Motor Frame Size: □1.65 in. (□42 mm)



| Model          | Motor Model | L1<br>inch (mm) | L2<br>inch (mm) | Weight<br>lb. (kg) | DXF  |
|----------------|-------------|-----------------|-----------------|--------------------|------|
| <b>AS46AA</b>  | ASM46AA     | 2.56 (64.9)     | —               | 1.1 (0.5)          | B192 |
| <b>AS46AAP</b> |             |                 |                 |                    |      |
| <b>AS46MA</b>  | ASM46MA     | —               | 3.74 (94.9)     | 1.3 (0.6)          | B193 |
| <b>AS46MAP</b> |             |                 |                 |                    |      |

2 Motor Frame Size: □2.36 in. (□60 mm)

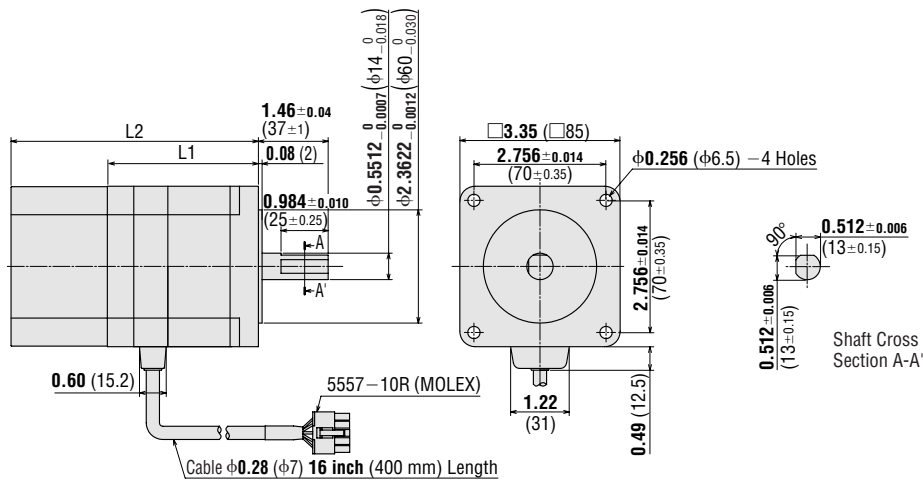


| Model           | Motor Model | L1<br>inch (mm) | L2<br>inch (mm) | Weight<br>lb. (kg) | DXF  |
|-----------------|-------------|-----------------|-----------------|--------------------|------|
| <b>AS66A</b> □  | ASM66A □    | 2.50 (63.6)     | —               | 1.9 (0.85)         | B194 |
| <b>AS66A</b> □P |             |                 |                 |                    |      |
| <b>AS66M</b> □  | ASM66M □    | —               | 3.88 (98.6)     | 2.4 (1.1)          | B195 |
| <b>AS66M</b> □P |             |                 |                 |                    |      |
| <b>AS69A</b> □  | ASM69A □    | 3.72 (94.6)     | —               | 3.1 (1.4)          | B272 |
| <b>AS69A</b> □P |             |                 |                 |                    |      |
| <b>AS69M</b> □  | ASM69M □    | —               | 5.1 (129.6)     | 3.6 (1.65)         | B273 |
| <b>AS69M</b> □P |             |                 |                 |                    |      |

● Enter the power supply voltage **A**, **C** or **S** in the box (□) within the model number.



### 3 Motor Frame Size: □3.35 in. (□85 mm)

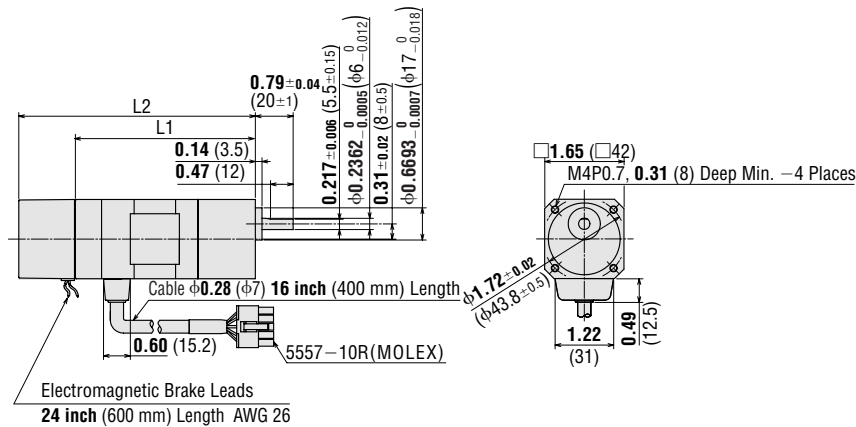


| Model            | Motor Model | L1<br>inch (mm) | L2<br>inch (mm) | Weight<br>lb. (kg) | DXF  |
|------------------|-------------|-----------------|-----------------|--------------------|------|
| <b>AS98A</b> □   | ASM98A□     | 3.15 (80)       | —               | 4.0 (1.8)          | B196 |
| <b>AS98A</b> □P  |             |                 |                 |                    |      |
| <b>AS98M</b> □   | ASM98M□     | —               | 5.16 (131)      | 4.8 (2.2)          | B235 |
| <b>AS98M</b> □P  |             |                 |                 |                    |      |
| <b>AS911A</b> □  | ASM911A□    | 4.33 (110)      | —               | 6.6 (3.0)          | B264 |
| <b>AS911A</b> □P |             |                 |                 |                    |      |

• Enter the power supply voltage **A**, **C**, or **S** in the box (□) within the model number.

### ◆ TH Geared Type

#### 4 Motor Frame Size: □1.65 in. (□42 mm)



| Model              | Motor Model | Gear Ratio                            | L1<br>inch (mm) | L2<br>inch (mm) | Weight<br>lb. (kg) | DXF  |
|--------------------|-------------|---------------------------------------|-----------------|-----------------|--------------------|------|
| <b>AS46AA-T</b> □  | ASM46AA-T□  | <b>3.6, 7.2,</b><br><b>10, 20, 30</b> | 3.76 (95.4)     | —               | 1.4 (0.65)         | B199 |
| <b>AS46AA-P</b> □  |             |                                       |                 |                 |                    |      |
| <b>AS46MA-T</b> □  | ASM46MA-T□  | —                                     | —               | 4.94 (125.4)    | 1.7 (0.75)         | B200 |
| <b>AS46MAP-T</b> □ |             |                                       |                 |                 |                    |      |

• Enter the gear ratio in the box (□) within the model number.

Introduction

AS AS PLUS

ASC

RK

CRKII

CSK

PMC

UMK

CSK

PK/PV

PK

UI2120G

EMP401

EMP402

SG8030J

SMK

Accessories

Before Using a Stepping Motor

Low-Speed Synchronous Motors

Controllers

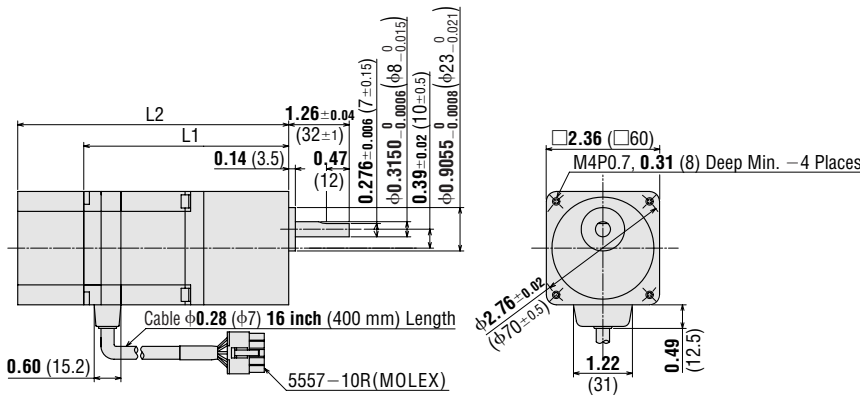
Driver

2-Phase Stepping Motors

Without Encoder

With Encoder

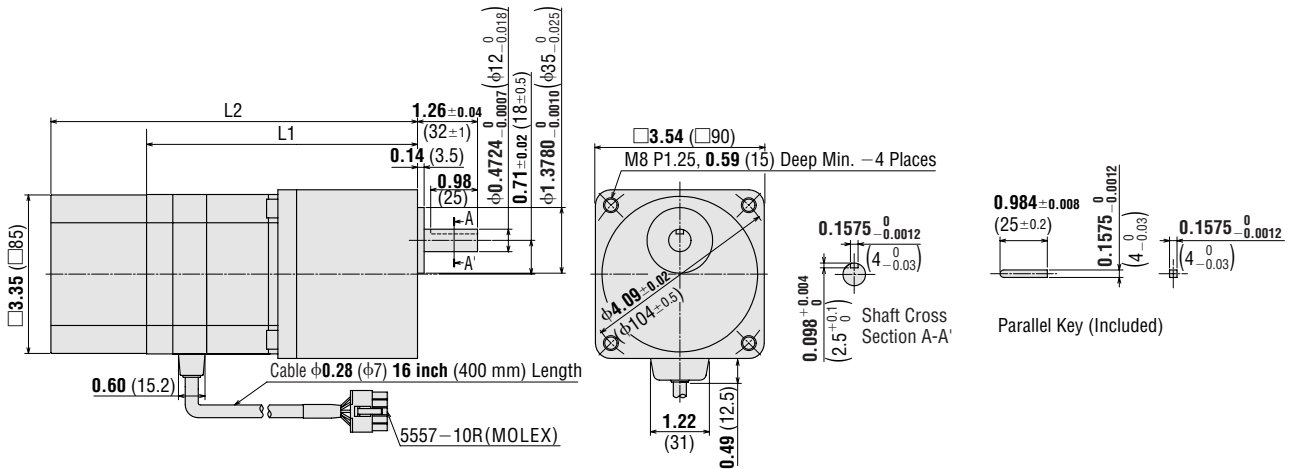
5 Motor Frame Size: □2.36 in. (□60 mm)



| Model       | Motor Model | Gear Ratio              | L1<br>inch (mm) | L2<br>inch (mm) | Weight<br>lb. (kg) | DXF  |
|-------------|-------------|-------------------------|-----------------|-----------------|--------------------|------|
| AS66A□-T□   | ASM66A□-T□  | 3.6, 7.2,<br>10, 20, 30 | 4.28 (108.6)    | —               | 2.8 (1.25)         | B201 |
| AS66A□-P-T□ |             |                         |                 |                 |                    |      |
| AS66M□-T□   | ASM66M□-T□  | 3.6, 7.2,<br>10, 20, 30 | —               | 5.65 (143.6)    | 3.3 (1.5)          | B202 |
| AS66M□-P-T□ |             |                         |                 |                 |                    |      |

- Enter the gear ratio in the box (□) within the model number.
- Enter the power supply voltage **A**, **C** or **S** in the box (□) within the model number.

6 Motor Frame Size: □3.54 in. (□90 mm)

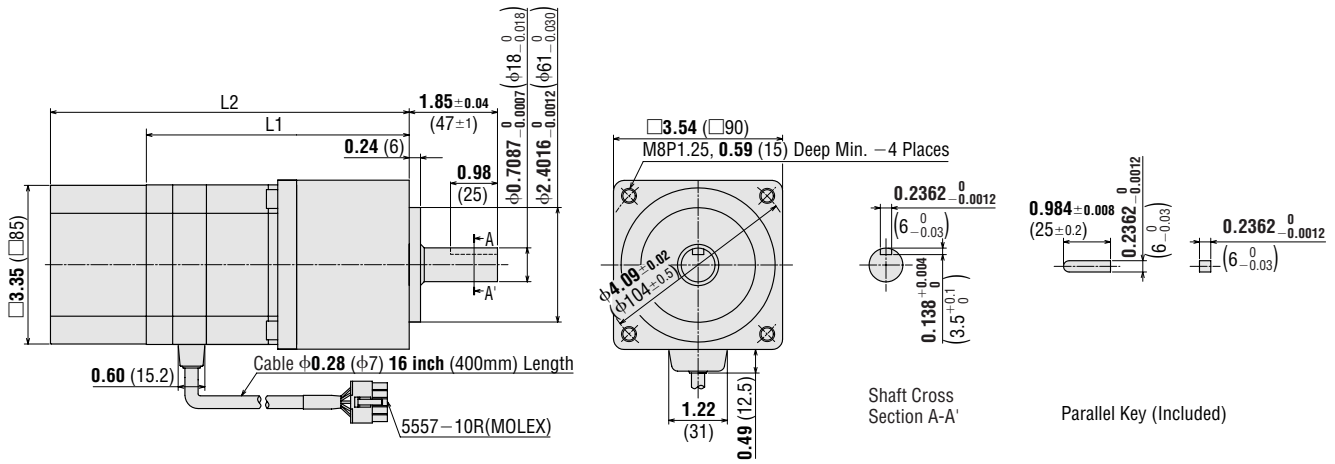


| Model       | Motor Model | Gear Ratio              | L1<br>inch (mm) | L2<br>inch (mm) | Weight<br>lb. (kg) | DXF  |
|-------------|-------------|-------------------------|-----------------|-----------------|--------------------|------|
| AS98A□-T□   | ASM98A□-T□  | 3.6, 7.2,<br>10, 20, 30 | 5.69 (144.5)    | —               | 6.6 (3.0)          | B203 |
| AS98A□-P-T□ |             |                         |                 |                 |                    |      |
| AS98M□-T□   | ASM98M□-T□  | 3.6, 7.2,<br>10, 20, 30 | —               | 7.70 (195.5)    | 7.5 (3.4)          | B236 |
| AS98M□-P-T□ |             |                         |                 |                 |                    |      |

- Enter the gear ratio in the box (□) within the model number.
- Enter the power supply voltage **A**, **C** or **S** in the box (□) within the model number.



9 Motor Frame Size: □3.54 in. (□90 mm)

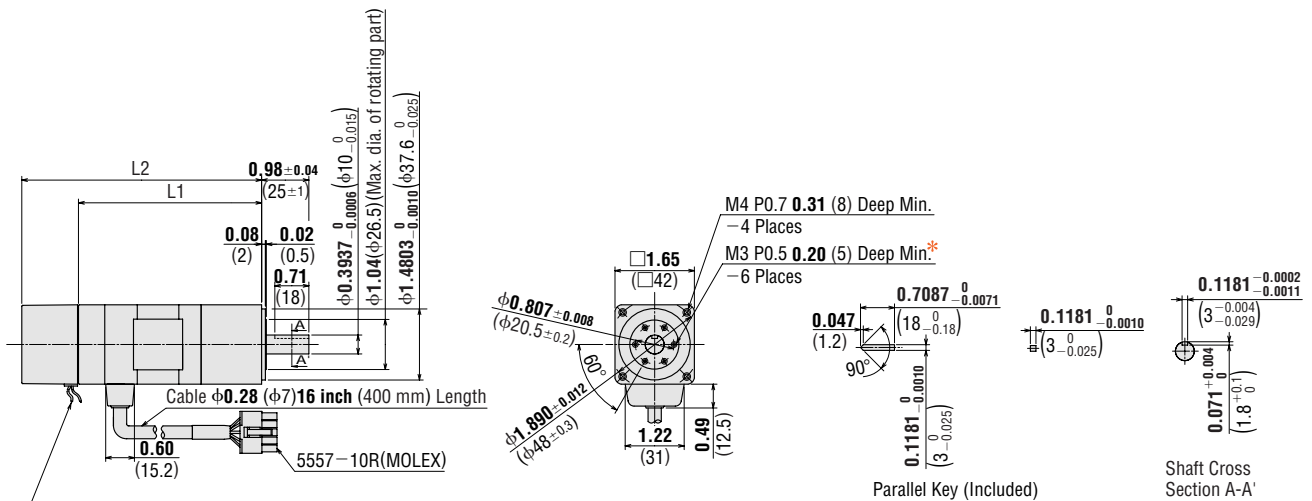


| Model       | Motor Model | Gear Ratio | L1<br>inch (mm) | L2<br>inch (mm) | Weight<br>lb. (kg) | DXF  |
|-------------|-------------|------------|-----------------|-----------------|--------------------|------|
| AS98A□-N□   | ASM98A□-N□  | 5, 7.2, 10 | 5.51 (140)      | —               | 8.8 (4.0)          | B230 |
| AS98A□-P-N□ |             |            |                 |                 |                    |      |
| AS98A□-N□   | ASM98A□-N□  | 25, 36, 50 | 6.42 (163)      | —               | 10 (4.7)           | B231 |
| AS98A□-P-N□ |             |            |                 |                 |                    |      |
| AS98M□-N□   | ASM98M□-N□  | 5, 7.2, 10 | —               | 7.52 (191)      | 9.7 (4.4)          | B239 |
| AS98M□-P-N□ |             |            |                 |                 |                    |      |
| AS98M□-N□   | ASM98M□-N□  | 25, 36, 50 | —               | 8.43 (214)      | 11 (5.1)           | B240 |
| AS98M□-P-N□ |             |            |                 |                 |                    |      |

- Enter the gear ratio in the box (□) within the model number.
- Enter the power supply voltage **A**, **C** or **S** in the box (□) within the model number.

◆ HG Geared Type

10 Motor Frame Size: □1.65 in. (□42 mm)



\* The position of the key slot on the output shaft [φ0.3937 (φ10)] relative to the screw holes on a maximum diameter of φ1.04 (φ26.5) on the rotating part is arbitrary.

| Model       | Motor Model | Gear Ratio | L1<br>inch (mm) | L2<br>inch (mm) | Weight<br>lb. (kg) | DXF  |
|-------------|-------------|------------|-----------------|-----------------|--------------------|------|
| AS46AA2-H□  | ASM46AA2-H□ | 50, 100    | 3.81 (96.9)     | —               | 1.5 (0.7)          | B308 |
| AS46AAP2-H□ |             |            |                 |                 |                    |      |
| AS46MA2-H□  | ASM46MA2-H□ | —          | —               | 5.0 (126.9)     | 1.8 (0.8)          | B309 |
| AS46MAP2-H□ |             |            |                 |                 |                    |      |

- Enter the gear ratio in the box (□) within the model number.

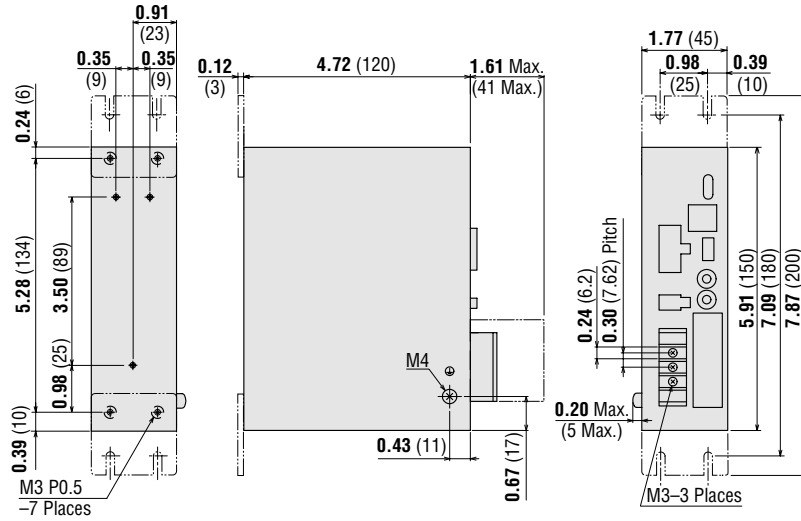


## ● Driver

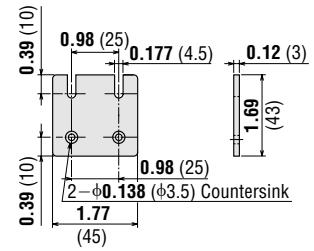
### 13 AS Series

Weight: 1.8 lb. (0.8 kg)

**DXF** B197



### ● Mounting Bracket (2 pieces, included)



### ● I/O Connector (included)

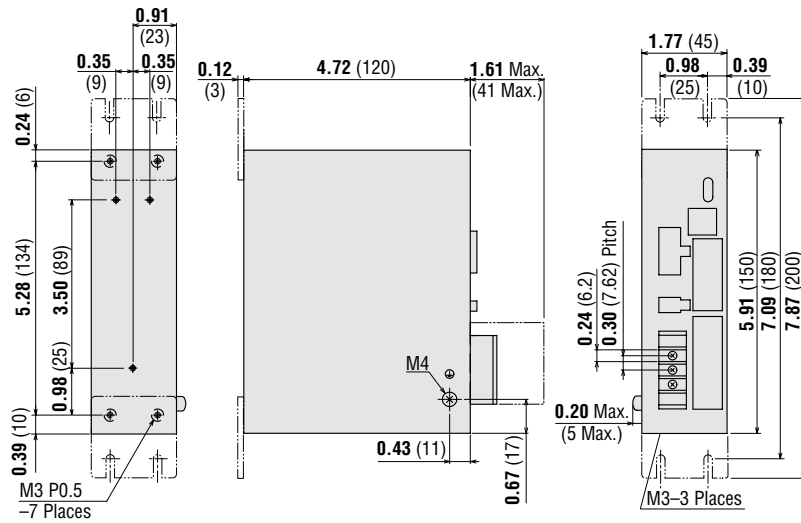
Connector: 54306-3619 (MOLEX)

Cover Assembly: 54331-0361 (MOLEX)

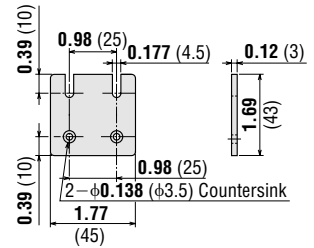
### 14 AS PLUS

Weight: 1.8 lb. (0.8 kg)

**DXF** B298



### ● Mounting Bracket (2 pieces, included)



### ● I/O Connector (included)

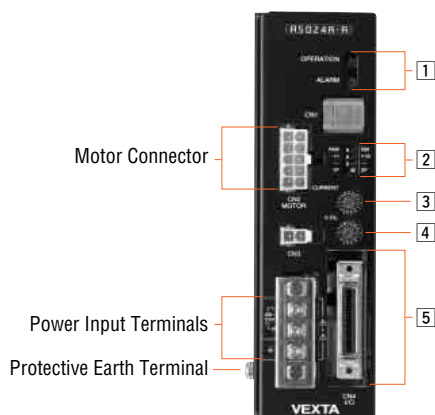
Connector (36 pin): 54306-3619 (MOLEX) for CN4

Cover Assembly (36 pin): 54331-0361 (MOLEX) for CN4

Connector (20 pin): 54306-2019 (MOLEX) for CN5

Cover Assembly (20 pin): 54331-0201 (MOLEX) for CN5

## Connection and Operation AS Series



### 1 Signal Monitor Display

#### • LED Indicators

| Indication | Color | Function                | When Activated                                  |
|------------|-------|-------------------------|---|
| OPERATION  | Green | Power Supply Indication | Lights when AC power is on.                     |
| ALARM      | Red   | Alarm Indication        | Blinks when protection functions are activated. |

#### • Alarm

| Blink Count | Protection Function | When Activated   |
|-------------|---------------------|--|
| 1           | Overheat            | The temperature of the driver's internal heat sink rises to approximately 185°F (85°C).      |
| 2           | Overload            | The motor is operated continuously over 5 seconds under a load exceeding the maximum torque. |
| 3           | Overvoltage         | The primary voltage of the driver's inverter exceeds the permissible value.                  |
| 4           | Speed error         | The motor cannot accurately follow at the indicated pulse velocity.                          |
| 5           | Overcurrent         | An excessive current has flowed to the driver's inverter.                                    |
| 6           | Overspeed           | The motor shaft velocity exceeds 5000 r/min. (Except for Gear Type)                          |
| 7           | EEPROM Data Error   | The EEPROM has a fault.  |
| 8           | Sensor Error        | The power source turns it on when the motor cable is not connected to the driver.            |
| No Blink    | System Error        | The driver has a fatal error.  |

### 2 Function Switches

| Indication       | Switch Name              | Function  |
|------------------|--------------------------|---|
| 1000/500 X1/ X10 | Resolution Select Switch | This function is for selecting the motor resolution.<br>For each geared type, the resolution of the gears output shaft is 1/gear ratio.<br>"1000" "×1" → 1000 pulses (0.36°/step)<br>"1000" "×10" → 10000 pulses (0.036°/step)<br>"500" "×1" → 500 pulses (0.72°/step)<br>"500" "×10" → 5000 pulses (0.072°/step) |
| 1P/2P            | Pulse Input Mode Switch  | The settings of this switch are compatible with the following two pulse input modes: "1P" for the 1-pulse input mode (step and direction), "2P" for the 2-pulse input mode (CW, CCW).   |

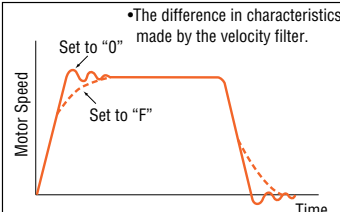
#### Note:

- Always turn the power off before switching resolution or pulse input, and turn it ON again after you have made the change.
- If the "Resolution Select" switch is set to "×10", it cannot control the resolution select by input terminal. It is always "×10".

### 3 Current Adjustment Switch

| Indication | Switch Name               | Function   |
|------------|---------------------------|--|
| CURRENT    | Current Adjustment Switch | The motor running current can be lowered to suppress temperature rise in the motor and driver, or lower operating current in order to allow a margin for motor torque. |

### 4 Velocity Filter Adjustment Switch

| Indication | Switch Name                       | Function   |
|------------|-----------------------------------|--|
| V.FIL      | Velocity Filter Adjustment Switch | This switch is used to make adjustments when a smooth start-stop or smooth motion at low speed is required.<br> |

### 5 Input/Output Signals

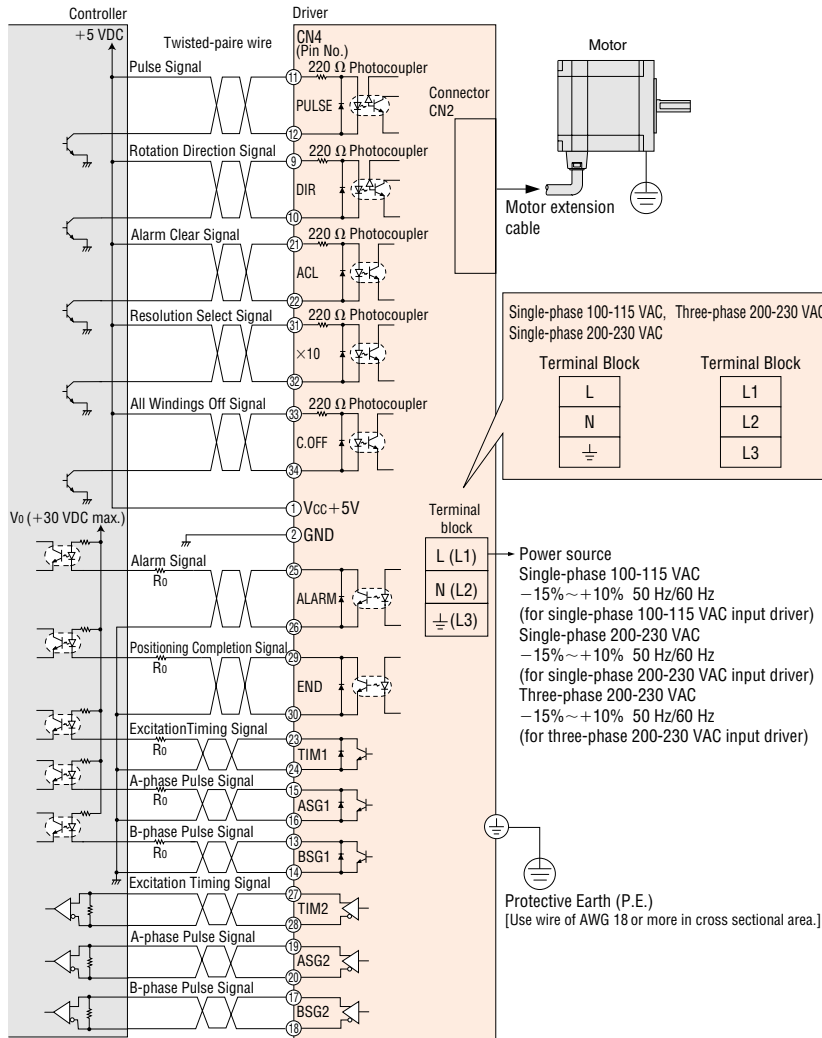
| Connector | Pin Number | Input/Output         | Signal       | Name of Signal                        |                   |
|-----------|------------|----------------------|--------------|---------------------------------------|-------------------|
| CN4       | 1          | External Power Input | Vcc + 5V*1   | Power supply for control signal       |                   |
|           | 2          |                      | GND          |                                       |                   |
|           | 3          |                      | Vcc + 24V*1  |                                       |                   |
|           | 9          | Input Signal         | CCW (DIR)    | CCW Pulse (Rotation Direction)*2      |                   |
|           | 10         |                      | CCW (DIR)    |                                       |                   |
|           | 11         |                      | CW (PLS)     | CW Pulse (Pulse)*2                    |                   |
|           | 12         |                      | CW (PLS)     |                                       |                   |
|           | 13         | Output Signal        | BSG1         | B-Phase Pulse Output (Open Collector) |                   |
|           | 14         |                      | GND          |                                       |                   |
|           | 15         |                      | ASG1         | A-Phase Pulse Output (Open Collector) |                   |
|           | 16         |                      | GND          |                                       |                   |
|           | 17         |                      | BSG2         | B-Phase Pulse Output (Line Driver)    |                   |
|           | 18         |                      | BSG2         |                                       |                   |
|           | 19         |                      | ASG2         | A-Phase Pulse Output (Line Driver)    |                   |
|           | 20         |                      | ASG2         |                                       |                   |
|           | 21         |                      | Input Signal | ACL                                   | Alarm Clear       |
|           | 22         |                      |              | ACL                                   |                   |
|           | 23         | Output Signal        | TIM1         | Timing (Open Collector)               |                   |
|           | 24         |                      | GND          |                                       |                   |
|           | 25         |                      | ALARM        | Alarm                                 |                   |
|           | 26         |                      | ALARM        |                                       |                   |
|           | 27         |                      | TIM2         | Timing (Line Driver)                  |                   |
|           | 28         |                      | TIM2         |                                       |                   |
|           | 29         |                      | END          | Positioning Completion                |                   |
|           | 30         |                      | END          |                                       |                   |
|           | 31         |                      | Input Signal | ×10                                   | Resolution Select |
|           | 32         |                      |              | ×10                                   |                   |
|           | 33         | C.OFF                |              | All Windings Off                      |                   |
|           | 34         | C.OFF                |              |                                       |                   |

\*1 Do not input 5 VDC and 24 VDC at the same time.

\*2 Value in parentheses represents the setting 1-pulse input mode. The setting at shipment is the 2-pulse input mode.



## ● Connection Diagrams AS Series

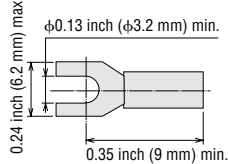
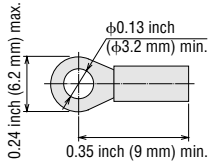


### Notes:

- $V_o$  and the current must be 30 VDC, 15 mA or less respectively. If the current exceeds 15 mA, connect external resistance  $R_o$ .
- Use a multi-core, twisted-pair shielded wire AWG 28 for the control input/output signal line (CN4), and keep wiring as short as possible [within 6.6 feet (2 m)].
- Note that as the length of the pulse signal line increases, the maximum transmission frequency decreases.
- When it is necessary to separate the motor and driver by more than 1.31 ft. (0.4 m), an optional extension cable or flexible cable must be used. Electromagnetic brake motor models (except motor frame size 1.65 inch (42 mm) must use an electromagnetic brake extension cable (sold separately). The frame size 1.65 inch (42 mm) models can use a standard extension cable even for electromagnetic brake motor models.
- Use a three-core cable for the power supply line with a conductor cross-sectional area of at least AWG 18. (single-phase 100-115 VAC, single-phase 200-230 VAC)
- Use a four-core cable for the power supply line with a conductor cross-sectional area of at least AWG 18. (three-phase 200-230 VAC)
- Keep the control input/output signal line at least 1 foot (300 mm) away from power lines (e.g. lines carrying large current, such as AC lines and motor lines). Also, do not run these lines through the same ducts or pipes as power lines.
- The customer must furnish the cables for power supply lines and control input/output signal lines.
- The driver must be properly grounded. The driver's Protective Earth terminal should be grounded to a common ground point, using a cable of AWG 18.
- When the "Timing Signal" or "Pulse Signal" is used, 5 VDC or 24 VDC power supply is necessary. Use either a 5 VDC or a 24 VDC power supply. Do not connect power to pins ① and ③ at the same time. See [5] Input/Output table on page C-39.

## ◆ Recommended Crimp Terminals

- Round shape terminals with insulator
- U shape terminals with insulator



\* Crimp terminals are not provided with the package. They must be furnished separately.

## ◆ Connecting the Electromagnetic Brake to Power Supply

Connect the electromagnetic brake to the power supply using a cable with a conductor cross-sectional area of at least AWG 24. The power supply input to the electromagnetic brake is 24 VDC  $\pm 5\%$  0.3 A min. (**AS46**: 0.1 A min.) and therefore must be independent of the driver's power supply.

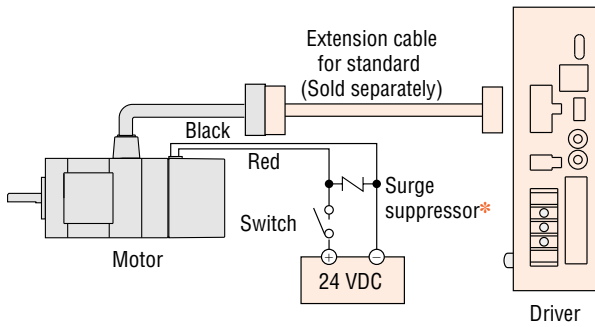
### Notes:

- Applying a voltage that exceeds the specifications will cause the electromagnetic brake to generate a great deal of heat, resulting in motor temperature rises and possible damage to the motor. Conversely, if voltage is too low, the electromagnetic brake may not release.
- To protect the switch contacts and prevent noise, always connect the accessory surge suppressor.
- To prevent noise, use a dedicated power supply for the electromagnetic brake.
- Correct polarity (+ and -) must be ensured when connecting the electromagnetic brake lead wire of **AS** series to the DC power supply. If polarity is incorrect, the electromagnetic brake will not operate properly.
- When using as a CE certified part, use a DC power supply with reinforced insulation for the primary side as the power supply for the electromagnetic brake.  
(\* The surge suppressor is included with electromagnetic brake motors.)

## Connection Method

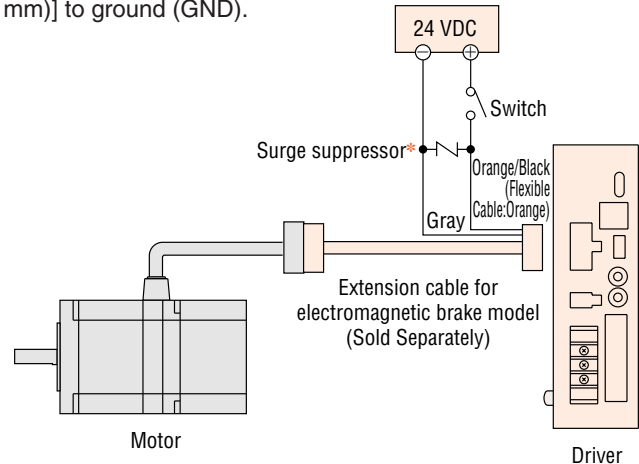
### AS46

The electromagnetic brake wire is linked to the connector on the motor [23.6 inch (600 mm)]. When connecting with the DC power supply, connect the red spiral lead wire to +24 V, and the black lead wire to the ground (GND). Use the extension cable or the movable cable (both sold separately) for standard.



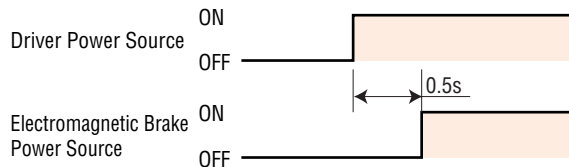
### AS66, AS69, AS98

The electromagnetic brake wire is linked to the connector on the driver connection side of extension cable for electromagnetic brake models (sold separately). Be sure to use the accessory (sold separately) extension cable or flexible cable. Connect the orange/black wire from the standard cable (orange wire for the flexible cable) [2.36 inch (60 mm)] to +24 V, and the gray lead wire [2.36 inch (60 mm)] to ground (GND).



## Timing Chart for Electromagnetic Brake Operation

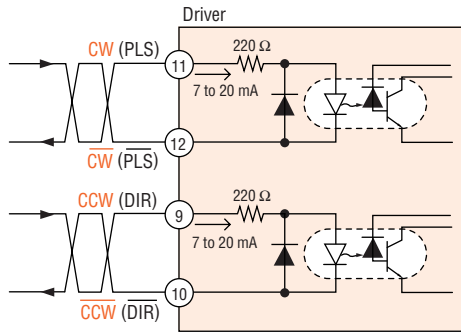
To release the electromagnetic brake, wait at least 0.5 seconds after turning on the driver power source. The load may fall down due to a loss of holding torque.



## ● Description of Input/Output Signals

### Pulse Input (CW) and Rotation Direction (CCW) Input Signal

#### ◆ Input Circuit and Sample Connection



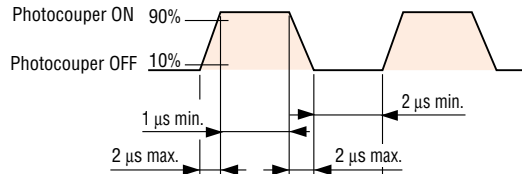
The letters indicate signals under the 2-pulse input mode, while the letters in parentheses indicate signals under the 1-pulse input mode. The factory setting is 2-pulse input mode.

#### Note:

- When  $V_o$  is equal to 5 VDC, external resistance is not necessary.
- When  $V_o$  is above 5 VDC, connect external resistance to keep the input current between 7 mA and 20 mA.

#### ◆ Pulse Waveform Characteristics

(Photocopier state corresponding to the input pulse)



For pulse signals, use input pulse waveforms like those shown in the figure above.

#### ◆ Pulse Input Mode

##### 1-Pulse Input Mode

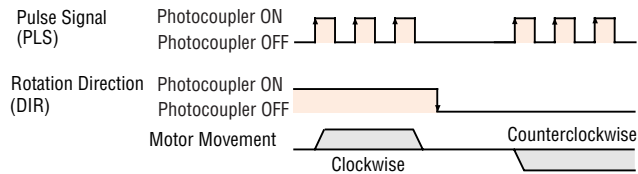
The 1-pulse input mode uses "Pulse" (PLS) and "Rotation Direction" (DIR) signals. CW is selected by inputting DIR signals at low level (with the input photocopier on), CCW by inputting at high level (with input photocopier off).

"Rotation Direction" signals

Photocopier "ON": Clockwise,

Photocopier "OFF": Counterclockwise

##### 1 Pulse Input Mode



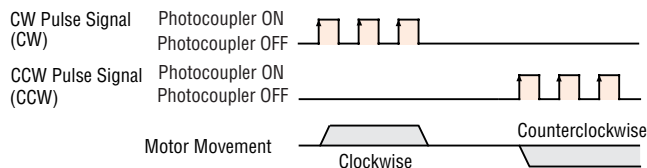
##### 2-pulse input mode

The 2-pulse input mode is used for "CW" and "CCW" pulses. When "CW" pulses are input, the motor's output shaft rotates clockwise when the motor is viewed facing the shaft; when "CCW" pulses are input, the shaft rotates counterclockwise.

#### Note:

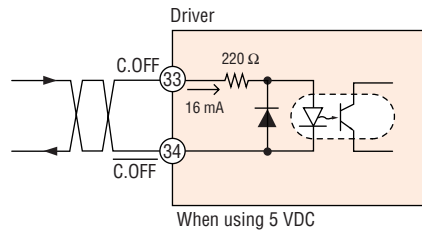
- The factory setting is 2-pulse input.

##### 2 Pulse Input Mode

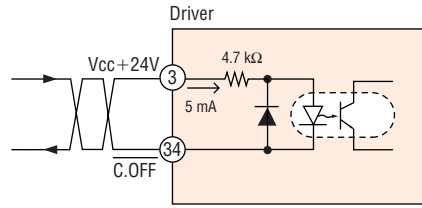


## All Windings Off (C.OFF) Input Signal

### ◆ Input Circuit and Sample Connection



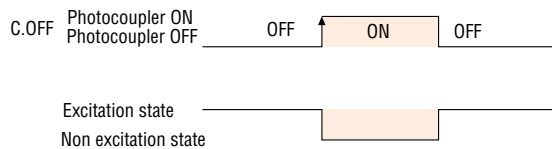
When using 5 VDC



When using 24 VDC

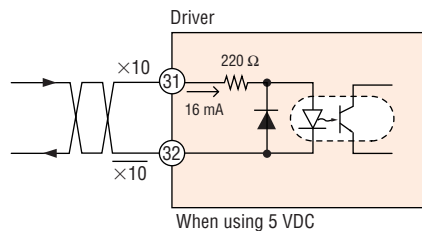
This controller power source offers a choice of either 5 VDC or 24 VDC.

Inputting the "All Windings Off" (C.OFF) signal puts the motor in a non-excitation (free) state. It is functioning when the photocopier is ON. It is used when turning the motor shaft externally or when positioning manually. This signal clears the deviation counter.

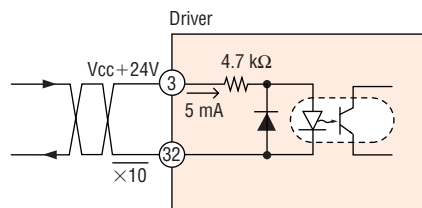


## Resolution Select (×10) Input Signal

### ◆ Input Circuit and Sample Connection



When using 5 VDC



When using 24 VDC

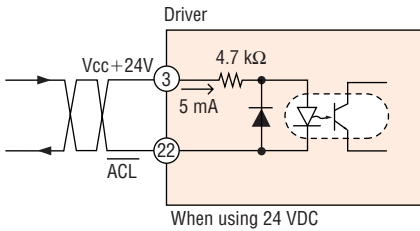
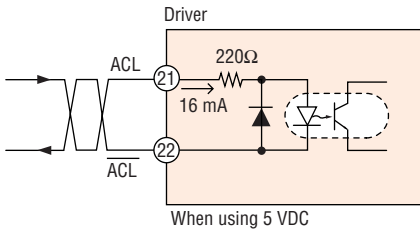
This controller power source offers a choice of either 5 VDC or 24 VDC. During input of this signal, the magnification of the resolution is ×10. It is only valid when the resolution select switch is set to ×1.

#### Note:

- When the resolution select switch is set to ×10, the "Resolution Select" Input is ignored. In this case, the "Resolution Select" Input is always equal to ON.

## Alarm Clear (ACL) Input Signal

### ◆ Input Circuit and Sample Connection



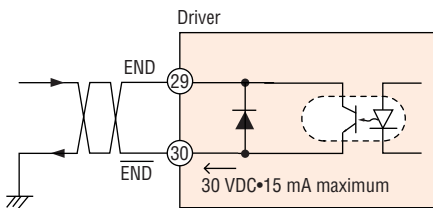
This controller power source offers a choice of either 5 VDC or 24 VDC. This signal is used when a protection circuit has been activated, for canceling the alarm without turning off power to the driver.

#### Note:

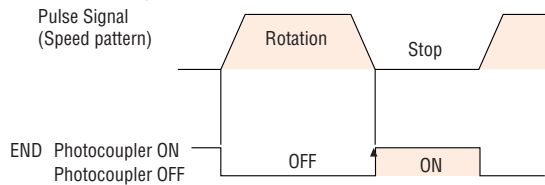
- The following alarm cannot be released. To cancel the alarm, first resolve the cause and check for safety, and then turn power on again.
  - Over Current ●EEPROM Data Error ●System Error

## Position Completion (END) Output Signal

### ◆ Output Circuit and Sample Connection



Circuits for use with 30 VDC, 15 mA maximum. This signal is output at the photocopier ON state when positioning is completed. This signal is output when the rotor position is less than  $\pm 1.8^\circ$  from the command position, approximately 2 ms after the pulse input stops.

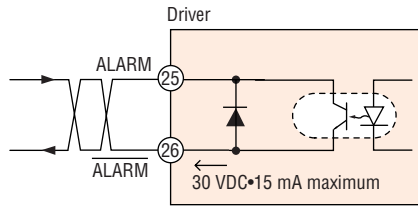


#### Note:

- The END signal flashes during operation with a pulse input frequency of 500 Hz or less.

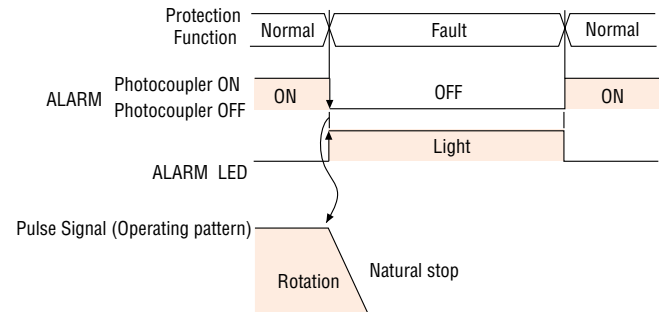
## Alarm (ALARM) Output Signal

### ◆ Output Circuit and Sample Connection



Circuits for use with 30 VDC, 15 mA maximum.

This signal indicates that one of the driver's protection circuits has been activated. When an abnormality such as an overload or over current is detected, the alarm signal is output, the ALARM indicator lights, and the motor stops (non-excitation state). To cancel the alarm, first resolve the cause and check for safety, and then input an Alarm-clear (ACL) signal or cycle power. Once power has been turned off, wait at least 10 seconds before turning it on again.



#### Note:

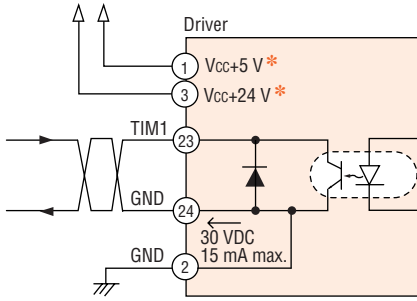
The alarm output uses positive logic (Normally Closed), all other outputs use negative logic (Normally Open).

## Excitation Timing (TIM.) Output Signal

### ◆ Output Circuit and Sample Connection

#### Open Collector Output (Current Source Type)

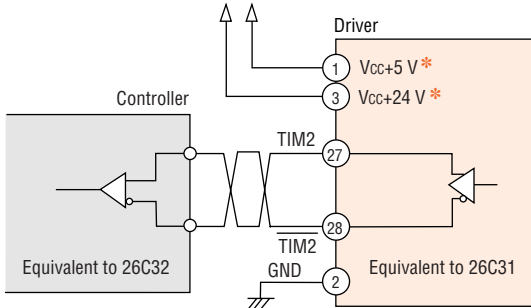
\*Power supply for timing output should be connected to either 5 VDC or 24 VDC.  
Do not input 5 VDC and 24 VDC at the same time.



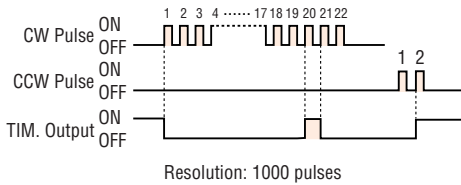
Circuits for use with 30 V, 15 mA maximum.

#### Line Driver Output

\*Power supply for timing output should be connected to either 5 VDC or 24 VDC.  
Do not input 5 VDC and 24 VDC at the same time.



When the "Excitation Timing" signal is output, the photocoupler turns ON (For the line driver output which is TIM2, the output signal is High). This signal can be used to detect the home position with greater precision. This signal is output 50 times per motor shaft revolution.



#### Notes:

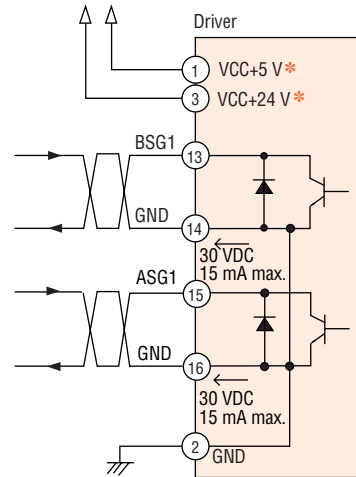
- A precise timing signal cannot be obtained when the speed of the pulse input frequency is over 500 Hz.
- When the Timing Signal Output is used, 5 VDC or 24 VDC power supply is necessary.

## Quadrature (ASG1/BSG1, ASG2/BSG2) Output Signal

### ◆ Output Circuit and Sample Connection

#### Open Collector Output (Current Source Type)

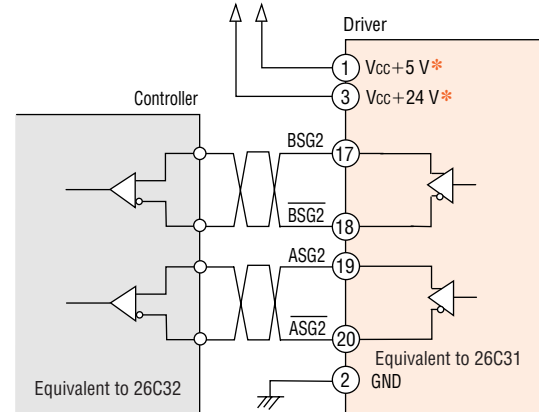
\*Power supply for quadrature output should be connected to either 5 VDC or 24 VDC.  
Do not input 5 VDC and 24 VDC at the same time.



Circuits for use with 30 V, 15 mA maximum.

#### Line Driver Output

\*Power supply for quadrature output should be connected to either 5 VDC or 24 VDC.  
Do not input 5 VDC and 24 VDC at the same time.



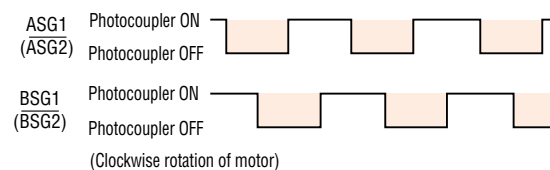
These signals are used when monitoring the motor position. The pulse resolution is the same as the motor resolution at the time of power-on.

[Example: Resolution select switch (1000 P/R)→Output pulse number for each motor revolution (1000).] The phase difference between A and B is 90° electrical.

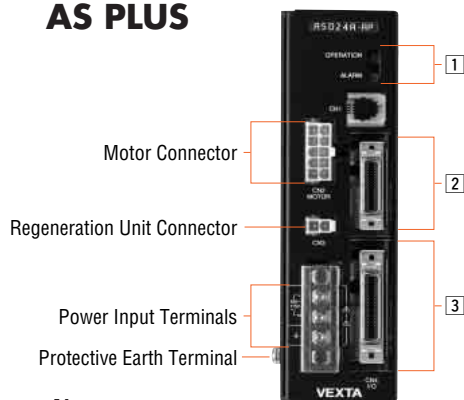
#### Notes:

- The pulse output accuracy is, regardless of resolution, within  $\pm 0.36^\circ$  (repetition accuracy: within  $0.09^\circ$ )
- When the "quadrature" signal output is used, 5 VDC or 24 VDC power supply is necessary. These signals are only for position verification when the motor is stopped. There is a 1 ms (max.) time lag between real rotor motion and the output signals.

### ◆ Pulse Waveform Characteristics



## Connection and Operation AS PLUS



### 1 Signal Monitor Display

#### • LED Indications

| Indication | Color | Function                | When Activated                                 |
|------------|-------|-------------------------|--|
| OPERATION  | Green | Power supply indication | Lights when AC power is on                     |
| ALARM      | Red   | Alarm indication        | Blinks when protective functions are activated |

#### • Alarm

| Blink Count | Protective Function                | When Activated  | Alarm Code Output     | Operation  | Reset           |
|-------------|------------------------------------|---|-----------------------|--|-----------------|
| 1           | Stack overflow                     | Too many nested LOOP, ENDL, CALL, etc.  | 90h<br>(Decimal: 144) | The program stops.<br>The motor performs<br>stop operation set<br>by MSTOPACT. | *<br>Possible   |
|             | Memory read error                  | The data stored in the memory is damaged.   | 91h<br>(Decimal: 145) |  |                 |
|             | Program reference error            | The called program does not exist.  | 94h<br>(Decimal: 148) |  |                 |
|             | Compilation error                  | The executed program is not executable.   | 95h<br>(Decimal: 149) |  |                 |
|             | Operation result overflow          | The operation result exceeds the range of<br>-8,388,608 to +8,388,607.  | 98h<br>(Decimal: 152) |  |                 |
|             | Parameter out-of-range error       | The parameter exceeds its setting range.  | 99h<br>(Decimal: 153) |  |                 |
|             | Divide by zero                     | Divide by zero was executed.  | 9Ah<br>(Decimal: 154) |  |                 |
|             | General I/O definition error       | The signal assignment method for general<br>I/O ports was not correct.  | 9Ch<br>(Decimal: 156) |  |                 |
|             | PC command execution error         | A PC command was executed while the<br>motor was operating or not energized.  | 9Dh<br>(Decimal: 157) |  |                 |
| 2           | Overheat protection                | The temperature of the heat sink in the<br>driver has reached approx. 185°F (85°C).   | 21h<br>(Decimal: 33)  | The motor loses its<br>holding torque.   | *<br>Possible   |
|             | Overload protection                | A load exceeding the maximum torque was<br>applied to the motor for the duration set by<br>the OLTIME command.  | 30h<br>(Decimal: 48)  |  |                 |
|             | Overspeed error                    | The speed of the motor's output shaft has<br>exceeded 5,000 r/min.  | 31h<br>(Decimal: 49)  |  |                 |
| 3           | Overvoltage protection             | The driver's primary inverter voltage has<br>exceeded the limit of tolerance.   | 22h<br>(Decimal: 34)  | The motor loses its<br>holding torque.   | *<br>Possible   |
| 4           | Excessive position deviation       | The position of the motor's output shaft has<br>deviated from the position specified by the<br>operation command, by at least the number of<br>revolutions set by the OVERFLOW command. | 10h<br>(Decimal: 16)  | The motor loses its<br>holding torque.   | *<br>Possible   |
| 5           | Overcurrent protection             | An excessive current has flowed into the<br>power element of the driver's inverter section.   | 20h<br>(Decimal: 32)  | The motor loses its<br>holding torque.   | *<br>Impossible |
| 6           | Emergency stop                     | An E-STOP signal has been input.  | 68h<br>(Decimal: 104) | The program stops.<br>The motor loses its<br>holding torque<br>(ESTOPACT = 0). | *<br>Possible   |
|             |                                    |   |                       |  |                 |
| 7           | Incorrect limit-sensor logic       | Both the +LS and -LS are ON simultaneously.   | 60h<br>(Decimal: 96)  | The motor stops<br>immediately.  | *<br>Possible   |
|             | Reverse limit-sensor<br>connection | The +LS and -LS are connected in reverse.   | 61h<br>(Decimal: 97)  |  |                 |
|             | Mechanical home seeking error      | Mechanical home seeking could not be<br>executed correctly.   | 62h<br>(Decimal: 98)  |  |                 |
|             | Overtravel                         | The motor has exceeded its hardware limit.  | 66h<br>(Decimal: 102) | The program stops.<br>The motor stops<br>immediately<br>(ESTOPACT= 1).         |                 |
|             | Software overtravel                | The motor has exceeded its software limit.  | 67h<br>(Decimal: 103) | Decelerates to a stop.   |                 |
|             | Emergency stop                     | An E-STOP signal has been input.  | 68h<br>(Decimal: 104) | The motor stops<br>immediately.  |                 |
|             | Invalid operation data             | An inoperable operation pattern has been<br>started.  | 70h<br>(Decimal: 112) | Motion is stopped.   |                 |
| 8           | Resolver sensor error              | The motor cable has not been connected or<br>a motor's error has occurred in a sensor.  | 42h<br>(Decimal: 66)  | The motor loses its<br>holding torque.   | *<br>Impossible |
|             | Initial rotor revolution error     | The driver's power was turned on while the<br>motor's output shaft was turning by external<br>force.  | 43h<br>(Decimal: 67)  |  |                 |
| 9           | NVRAM error                        | Motor control parameters has been damaged.  | 41h<br>(Decimal: 65)  | The motor loses its<br>holding torque.   | *<br>Impossible |
| Stays ON.   | System error                       | Driver failure has occurred.  | F0h<br>(Decimal: 240) | The motor loses its<br>holding torque.   | *<br>Impossible |

\* Possible – The Alarm can be cleared with the ALMCLR command or an ACL input.

Impossible – The AC power must be cycled to clear these alarms.



## 2 Limit Sensor Input Communication Signals (CN5)

| Connector | Pin No. | Input/Output | Signal | Signal Name                          |
|-----------|---------|--------------|--------|--------------------------------------|
| CN5       | 1       | Input        | COM1   | Power source for input signals       |
|           | 2       |              | COM2   | Power source for input signals       |
|           | 3       | -            | -      | No Connection                        |
|           | 4       | -            | -      | No Connection                        |
|           | 5       | Output       | TX     | RS-232C Transmit                     |
|           | 6       | -            | -      | No Connection                        |
|           | 7       | Input        | RX     | RS-232C Receive                      |
|           | 8       | -            | -      | No Connection                        |
|           | 9       | -            | -      | No Connection                        |
|           | 10      | Input        | N24    | External power supply terminal (GND) |
|           | 11      | Input        | COM1   | Power source for input signals       |
|           | 12      |              | COM2   | Power source for input signals       |
|           | 13      |              | +LS    | +LS limit sensor                     |
|           | 14      |              | -LS    | -LS limit sensor                     |
|           | 15      |              | HOMELS | HOME sensor                          |
|           | 16      |              | SENSOR | Sensor                               |
|           | 17      |              | -      | No connection                        |
|           | 18      |              | -      | No connection                        |
|           | 19      |              | COM1   | Power source for input signals       |
|           | 20      |              | COM2   | Power source for input signals       |

## 3 I/O Signals (CN4)

| Connector | Pin No. | Input/Output | Signal                                       | Signal Name                                    |  |
|-----------|---------|--------------|--|--|--|
| CN4       | 1       | Input        | P24  | Power source for RS-232C, ASG and BSG (24 VDC) |  |
|           | 2       |              | N24  | Power source for RS-232C, ASG and BSG (GND)    |  |
|           | 3       | Output       | Y0   | General output*1<br>(Y0 to Y3)                 |  |
|           | 4       |              | Y0   |  |  |
|           | 5       |              | Y1   |  |  |
|           | 6       |              | Y1   |  |  |
|           | 7       |              | Y2   |  |  |
|           | 8       |              | Y2   |  |  |
|           | 9       |              | Y3   |  |  |
|           | 10      |              | Y3   |  |  |
|           | 11      |              | ASG  |  | Phase A pulse output<br>(Line-driver output) |
|           | 12      |              | ASG  |  | Phase A pulse output<br>(Line-driver output) |
|           | 13      | BSG          | Phase B pulse output<br>(Line-driver output) |  |  |
|           | 14      | BSG          | Phase B pulse output<br>(Line-driver output) |  |  |
|           | 15      | START        | START  |  |  |
|           | 16      | Input        | E-STOP                                       | Emergency stop                                 |  |
|           | 17      |              | COM1   | Power source for input signal                  |  |
|           | 18      | Output       | Y4   | General output*1<br>(Y4 to Y7)                 |  |
|           | 19      |              | Y4   |  |  |
|           | 20      |              | Y5   |  |  |
|           | 21      |              | Y5   |  |  |
|           | 22      |              | Y6   |  |  |
|           | 23      |              | Y6   |  |  |
|           | 24      |              | Y7   |  |  |
|           | 25      |              | Y7   |  |  |
|           | 26      |              | Y7   |  |  |
|           | 27      |              | ALM  |  | Alarm  |
|           | 28      | ALM          |  |  |  |
|           | 29      | Input        | X0   | General input*2<br>(X0 to X7)                  |  |
|           | 30      |              | X1   |  |  |
|           | 31      |              | X2   |  |  |
|           | 32      |              | X3   |  |  |
|           | 33      |              | X4   |  |  |
|           | 34      |              | X5   |  |  |
|           | 35      |              | X6   |  |  |
|           | 36      |              | X7   |  |  |

\*1: The following signals can be assigned arbitrarily via program settings. Additionally, the output logic of each signal can be switched. END output, RUN output, MOVE output, HOME-P output, TIM output, MBC output

\*2: The following signals can be assigned arbitrarily via program settings. Additionally, the input logic of each signal can be switched. ACL input, PAUSE input, MSTOP input, RESTART input

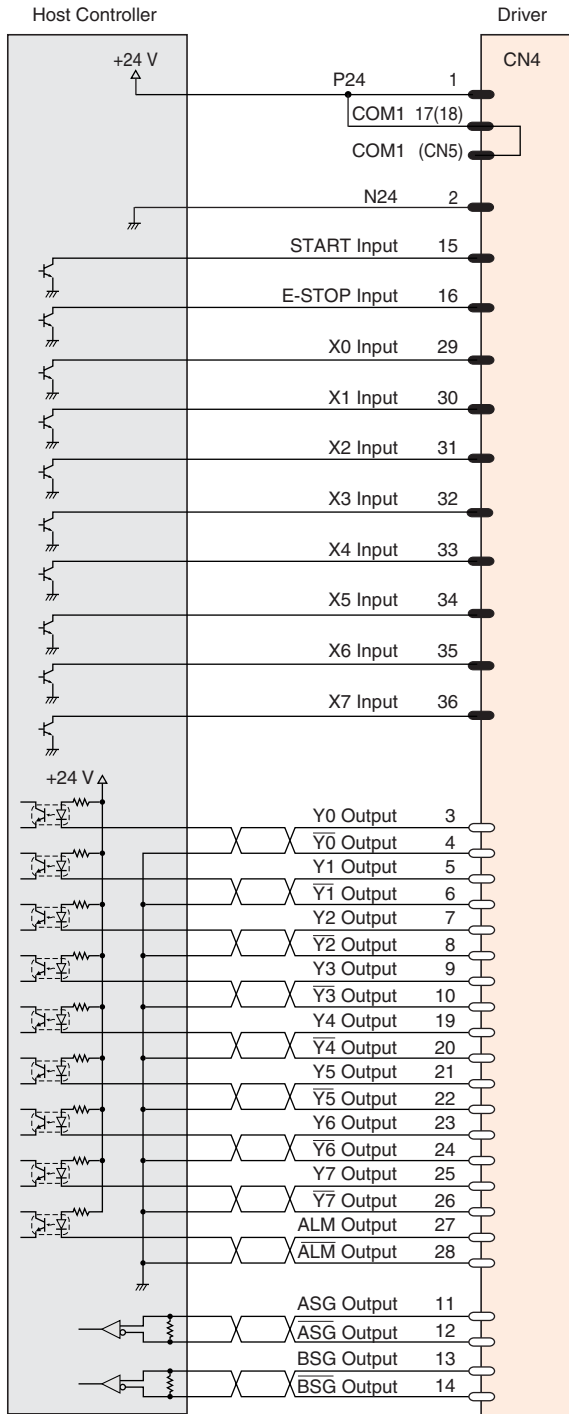


● Connection Diagrams

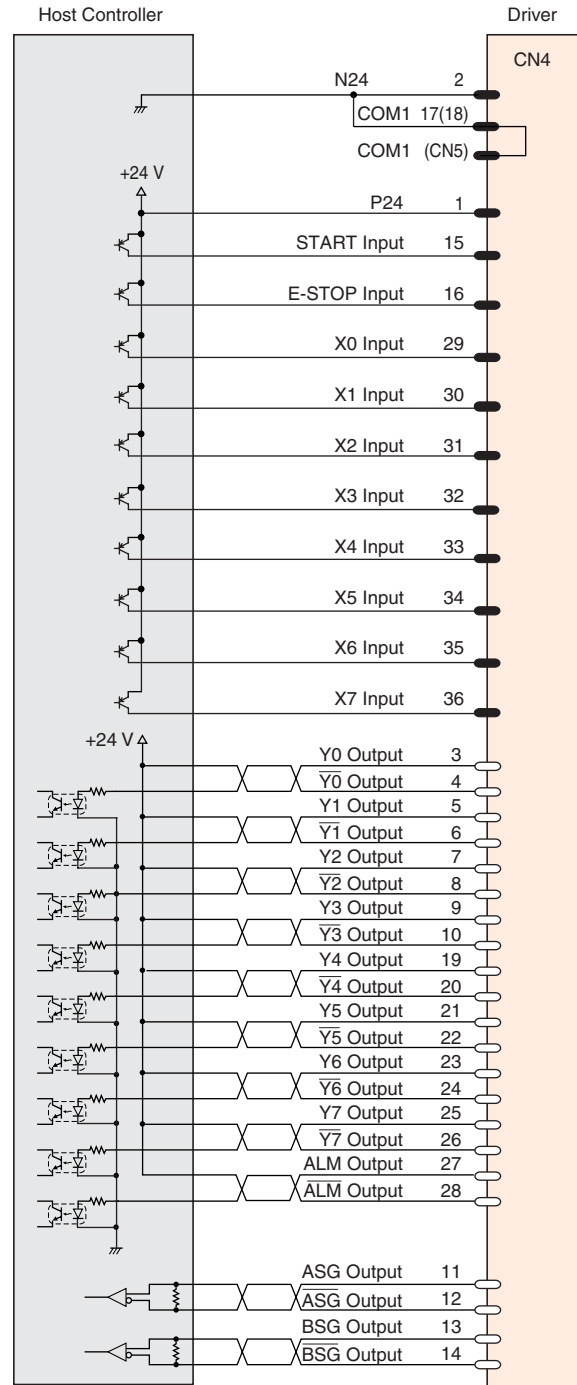
**AS PLUS**

◆ Power Lines and I/O Signals (CN4)

• Current source input and current sink output



• Current sink input current source output



Introduction

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AS PLUS

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Motor & Driver Packages

2-Phase Stepping Motors

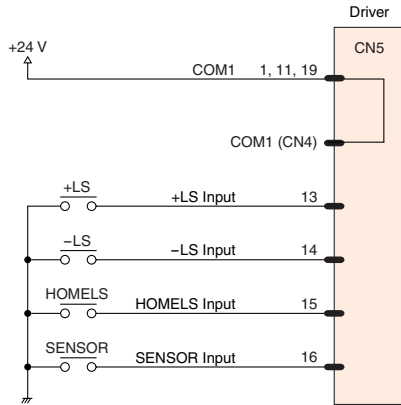
Controllers

Low-Speed Synchronous Motors

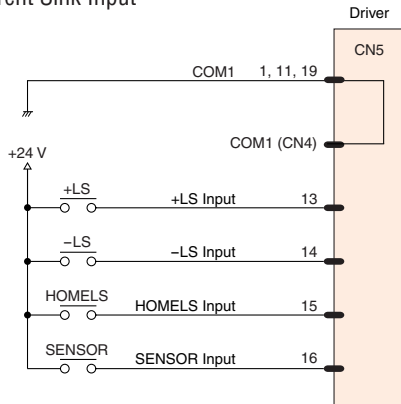
Before Using a Stepping Motor

## ◆ Power Lines and Limit Sensors (CN5)

### • Current Source Input



### • Current Sink Input



## ◆ Wiring the signal cable

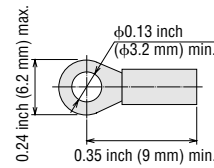
- Use input signals at 24 VDC  $\pm$  10%.
- Use output signals at 30 VDC or below and at 4 to 8 mA.
- Use a shielded cable with a wire of a size ranging between AWG 24 and AWG 22 for the driver signal cable (I/O signals, limit sensors signals), and keep it as short as possible.
- Keep the control input/output signal line at least 1 foot (300 mm) away from power lines (e.g. lines carrying large current, such as AC lines and motor lines). Also, do not run these lines through the same ducts or pipes as power lines.

## ◆ Other wiring

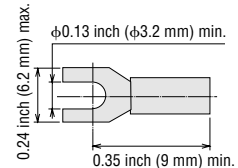
- When it is necessary to separate the motor and driver by more than 1.31 ft. (0.4 m), an optional extension cable or flexible cable must be used. Electromagnetic brake motor models (except motor frame size 1.65 inch (42 mm)) must use an electromagnetic brake extension cable (sold separately). The frame size 1.65 inch (42 mm) models can use a standard extension cable even for electromagnetic brake motor models.
- Use a three-core cable for the power supply line with a conductor cross-sectional area of at least AWG 18.
- The customer must furnish the cables for power supply lines and control input/output signal lines.
- The driver must be properly grounded. The driver's Protective Earth terminal should be grounded to a common ground point, using a cable of AWG 18.

## ◆ Recommended Crimp Terminals

Round shape terminals with insulator



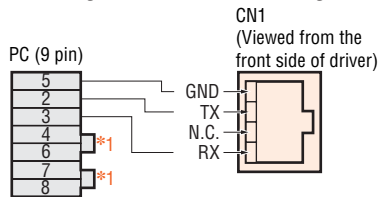
U shape terminals with insulator



\* Crimp terminals are not provided with the package. They must be furnished separately.

## ◆ Connecting the Driver with a Personal Computer (CN1)

### • Pin Assignments and Connecting



\*1 Short pins 4 and 6 together, as well as pins 7 and 8 together.

### • Communication Specifications

| Item                       | Description   |
|----------------------------|---|
| Electrical characteristics | In conformance with RS-232C.  |
| Transmission method        | Start-stop asynchronous method, NRZ (non-return to Zero), full-duplex |
| Data length                | 8 bits, 1 stop bit, no parity   |
| Transmission speed         | 9,600 bps   |
| Protocol                   | TTY (CR+LF)   |
| Connector specification    | Modular (4 lines, 4 pins)   |

### Notes:

- Confirm that 24 VDC is supplied to the driver's external power supply input terminals (P24 and N24).
- Use the RS-232C signal lines over the shortest possible distance. It is recommended that the signal lines be shielded to protect them from noise interference.
- The maximum distance between drivers when using a daisy chain connection should be 49.2 feet (15 m).

## ◆ Connecting the Electromagnetic Brake to Power Supply

Connect the electromagnetic brake to the power supply using a cable with a conductor cross-sectional area of at least AWG 24. The power supply input to the electromagnetic brake is 24 VDC  $\pm 5\%$  0.3 A min. (**AS46**: 0.1 A min.) and therefore must be independent of the driver's power supply.

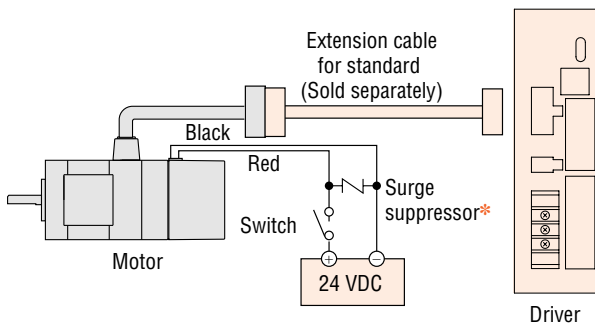
### Notes:

- Applying a voltage that exceeds the specifications will cause the electromagnetic brake to generate a great deal of heat, resulting in motor temperature rises and possible damage to the motor. Conversely, if voltage is too low, the electromagnetic brake may not release.
- To protect the switch contacts and prevent noise, always connect the accessory surge suppressor.
- To prevent noise, use a dedicated power supply for the electromagnetic brake.
- Correct polarity (+ and -) must be ensured when connecting the electromagnetic brake lead wire of **AS** series to the DC power supply. If polarity is incorrect, the electromagnetic brake will not operate properly.
- When using as a CE certified part, use a DC power supply with reinforced insulation for the primary side as the power supply for the electromagnetic brake.  
(\* The surge suppressor is included with electromagnetic brake motors.)

## Connection Method

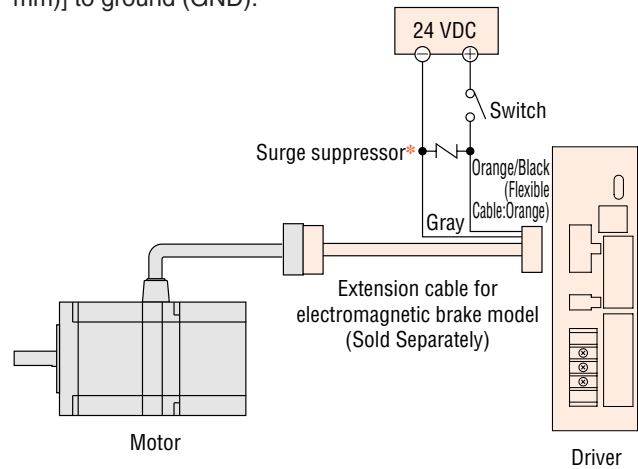
### AS46

The electromagnetic brake wire is linked to the connector on the motor [23.6 inch (600 mm)]. When connecting with DC power supply, connect the red spiral lead wire to +24 V, and the black lead wire to the ground (GND). Use the extension cable or the movable cable (both sold separately) for standard type.



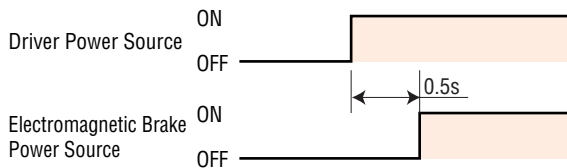
### AS66, AS69, AS98

The electromagnetic brake wire is linked to the connector on the driver connection side of extension cable for electromagnetic brake models (sold separately). Be sure to use the accessory (sold separately) extension cable or movable cable. Connect the orange/black wire from the standard cable (orange wire for the flexible cable) [2.36 in. (60 mm)] to +24 V, and the gray lead wire [2.36 inch (60 mm)] to ground (GND).



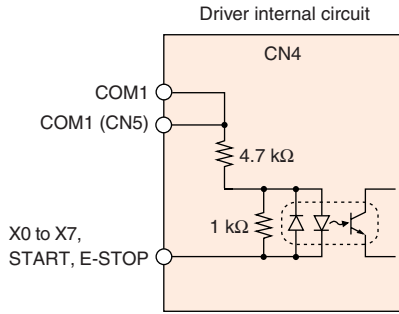
## Timing Chart for Electromagnetic Brake Operation

To release the electromagnetic brake, wait at least 0.5 seconds after turning on the driver power source. The load may fall down due to a loss of holding torque.



## ● Description of Input Signals (CN4)

### ◆ Input Circuit and Sample Connection



#### Note:

- Use input signals at  $24\text{ VDC} \pm 10\%$ .

#### • P24 input, N24 input

These inputs are for the external power supply required for the RS-232C communication, ASG and BSG line driver outputs. Make sure to use a power supply of at least  $24\text{ VDC} \pm 10\%$ , 0.05A.

If the same power supply is going to be used for the RS-232C, ASG, BSG and other external I/O, make sure to use a power supply of at least  $24\text{ VDC} \pm 10\%$ , 0.2A.

#### • START input

This signal starts the program named "STARTUP".  
OFF→ON edge to start "STARTUP" program.

#### • E-STOP input

This signal is used to forcibly stop the operation.  
Set the stopping method using the ESTOPACT command.  
Additionally, the input logic can be changed using the ESTOPLV command. (The factory setting of this command is normally open.)  
OFF→ON edge to stop operation

#### • COM1 input

This is an external power-source terminal for input signals.  
This signal is internally connected to terminals COM1 of CN5.

#### • X0 to X7 inputs

The X0 through X7 inputs can be used as input ports for general signals. The status of each port can be read using an IN command or INx command.

The general signals assignable to the X0 through X7 inputs are listed below. Use a corresponding command to assign signal.

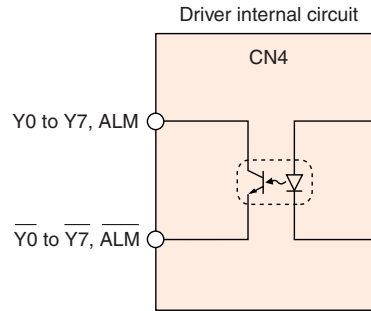
ACL input .....INACL command  
PAUSE input.....INPAUSE command  
MSTOP input.....INMSTOP command  
RESTART input.....INRESTART command

#### • ACL input

This signal is used to reset the alarm that has been generated by the driver's protective function.  
Input an ACL signal once after removing the cause that has triggered the protective function.

## ● Description of Output Signals (CN4)

### ◆ Output Circuit and Sample Connection



#### Note:

- Use output signals at 30 VDC or below and at 4 to 8 mA.

#### • Y0 to Y7 output

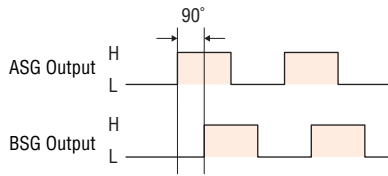
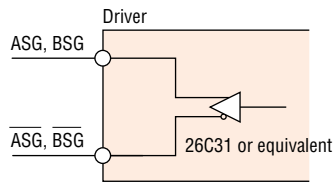
The Y0 through Y7 outputs can be used as output ports for general signals. The status of each port can be read using an OUT command or OUTx command.

The general signals assignable to the Y0 through Y7 outputs are listed below. Use the corresponding command to assign each signal.

END output.....OUTEND command  
RUN output .....OUTRUN command  
MOVE output.....OUTMOVE command  
HOME-P output.....OUTHOMEP command  
TIM output .....OUTTIM command  
MBC output.....OUTMBC command

## ASG, BSG Output

- Line driver output (26C31 or equivalent)



## ● ASG, BSG Line Driver Output

To monitor the motor position, connect these signals to a counter, etc.

The pulse resolution is the same as the motor resolution at the time of power-on.

The ASG output and BSG output have a phase difference of 90 degrees electrical.

Pulse output is subject to a maximum delay of 1 ms relative to the motor's motion. Use the ASG output and BSG output to check the stopping position.

## ● ALM Output

This signal is output when an alarm is generated by the driver's protective function.

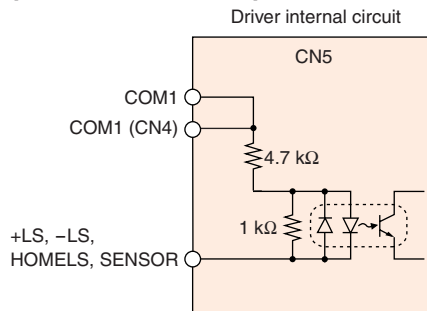
The reason for triggering of the protective function can be identified through the blink count of the alarm LED, or ALM command.

To reset the ALM output, remove the cause of the alarm and then perform one of the following procedures after ensuring safety:

- Assign INACL then turn the ACL input to ON.
- Enter an ALMCLR command.
- Turn off the AC power, wait at least 10 seconds, then turn it back on.

## ● Description of Limit Sensors (CN5)

### ◆ Input Circuit and Sample Connection



#### Note:

- Use input signals at 24 VDC $\pm$ 10%.

#### ● COM1 input

This is a power-source input terminal for limit-sensor signals. The power-source voltage must be 24 VDC $\pm$ 10%.

This signal is internally connected to terminals COM1 of CN4.

#### ● COM2 input

This is a power-source input terminal for limit-sensor signals.

Use it when sharing the input signal power source among two or more drivers.

#### ● +LS input, -LS input

These signals are input from +LS and -LS.

The input logic can be changed using the OTLV command. (The factory setting of this command is normally open.) Input logic for the +LS input and -LS input cannot be set separately.

#### Continuous Operation and Positioning Operation

When a +LS or -LS is detected, the driver's protective function (over travel) is activated. As a result, the ALM output is turned OFF and the motor stops.

Set the stopping method using the OTACT command.

To pull out of +LS or -LS, cancel the protective function by inputting an ACL signal once or by using the ALMCLR command.

Then perform mechanical home seeking routine or operate the motor in the direction opposite that of the limit sensor during continuous operation.

#### Mechanical Home Seeking Routine

When a +LS or -LS is detected, the motor operates in the direction opposite that of the detected limit.

- **HOMELS input**

This signal is input from HOMELS.

Connect the HOMELS when mechanical home seeking is performed in 3-sensor mode.

When mechanical home seeking is performed in 3-sensor mode, the HOMELS becomes the mechanical home. The input logic can be changed using the HOMELV command. (The factory setting of this command is normally open.)

- **SENSOR input**

This signal is input from SENSOR.

The input logic can be changed using the SENSORLV command. (The factory setting of this command is normally open.)

**Mechanical Home Seeking Routine**

This input is used when detecting the mechanical home at a specific point on the motor's output shaft or load shaft using a slotted disc, etc. The accuracy of mechanical home hunting increases if this input is used in conjunction with the TIM signal.

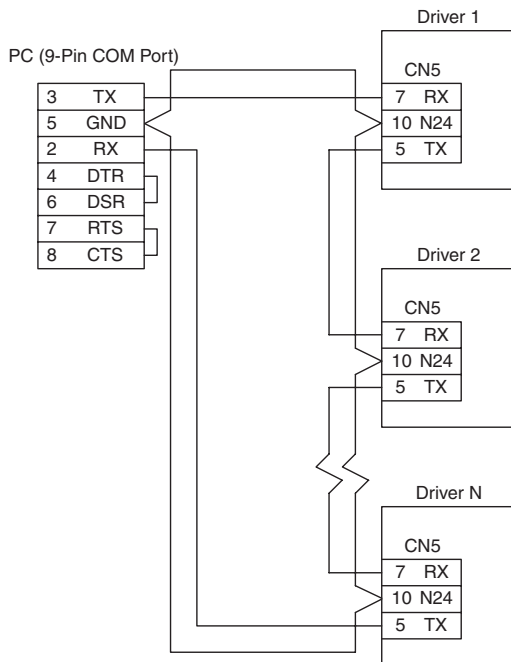
**Continuous Operation**

The motor can be stopped forcibly upon the detection of SENSOR.

Set the stopping method using the SENSORACT command.

**Note:**

- If the SENSOR input is used in mechanical home hunting, it cannot be used during continuous operation.



- **Description of Daisy-chain Connections**

Use the RS-232C communication pins (TX, RX and N24) of the sensor connector (CN5) when connecting two or more drivers via a daisy chain (up to 36 drivers).

- **TX, RX**

These communication terminals are used when implementing daisy-chain connections.

**Notes:**

- Confirm that each driver is supplied 24 VDC  $\pm$  10% (P24 and N24) of CN4 from outside for communication.
- Wire the RS-232C signal lines over the shortest possible distance. It is recommended that the signal lines be shielded to protect them from noise interference.
- The maximum distance between drivers when using a daisy chain connection should be 49.2 feet (15 m).
- Do not use the RS-232C communication port (CN1).

## List of Motor and Driver Combinations

### Single-Phase 100-115 VAC

| Type               | AS                  |               |                     | AS PLUS              |               |              |
|--------------------|---------------------|---------------|---------------------|----------------------|---------------|--------------|
|                    | Package Model       | Motor Model   | Driver Model        | Package Model        | Motor Model   | Driver Model |
| Standard           | <b>AS46□A</b>       | ASM46□A       | ASD13A-A            | <b>AS46□AP</b>       | ASM46□A       | ASD13A-AP    |
|                    | <b>AS66□A</b>       | ASM66□A       | ASD24A-A            | <b>AS66□AP</b>       | ASM66□A       | ASD24A-AP    |
|                    | <b>AS69□A</b>       | ASM69□A       | ASD30D-A            | <b>AS69□AP</b>       | ASM69□A       | ASD30D-AP    |
|                    | <b>AS98□A</b>       | ASM98□A       | ASD30A-A            | <b>AS98□AP</b>       | ASM98□A       | ASD30A-AP    |
|                    | <b>AS911AA</b>      | ASM911AA      | ASD30E-A            | <b>AS911AAP</b>      | ASM911AA      | ASD30E-AP    |
| TH Geared          | <b>AS46□A-T3.6</b>  | ASM46□A-T3.6  | ASD13B-A            | <b>AS46□AP-T3.6</b>  | ASM46□A-T3.6  | ASD13B-AP    |
|                    | <b>AS46□A-T7.2</b>  | ASM46□A-T7.2  |                     | <b>AS46□AP-T7.2</b>  | ASM46□A-T7.2  |              |
|                    | <b>AS46□A-T10</b>   | ASM46□A-T10   |                     | <b>AS46□AP-T10</b>   | ASM46□A-T10   |              |
|                    | <b>AS46□A-T20</b>   | ASM46□A-T20   | ASD13C-A            | <b>AS46□AP-T20</b>   | ASM46□A-T20   | ASD13C-AP    |
|                    | <b>AS46□A-T30</b>   | ASM46□A-T30   | ASD24B-A            | <b>AS46□AP-T30</b>   | ASM46□A-T30   | ASD24B-AP    |
|                    | <b>AS66□A-T3.6</b>  | ASM66□A-T3.6  |                     | <b>AS66□AP-T3.6</b>  | ASM66□A-T3.6  |              |
|                    | <b>AS66□A-T7.2</b>  | ASM66□A-T7.2  |                     | <b>AS66□AP-T7.2</b>  | ASM66□A-T7.2  |              |
|                    | <b>AS66□A-T10</b>   | ASM66□A-T10   |                     | <b>AS66□AP-T10</b>   | ASM66□A-T10   |              |
|                    | <b>AS66□A-T20</b>   | ASM66□A-T20   | ASD24C-A            | <b>AS66□AP-T20</b>   | ASM66□A-T20   | ASD24C-AP    |
|                    | <b>AS66□A-T30</b>   | ASM66□A-T30   | ASD30A-A            | <b>AS66□AP-T30</b>   | ASM66□A-T30   | ASD30A-AP    |
|                    | <b>AS98□A-T3.6</b>  | ASM98□A-T3.6  |                     | <b>AS98□AP-T3.6</b>  | ASM98□A-T3.6  |              |
|                    | <b>AS98□A-T7.2</b>  | ASM98□A-T7.2  |                     | <b>AS98□AP-T7.2</b>  | ASM98□A-T7.2  |              |
|                    | <b>AS98□A-T10</b>   | ASM98□A-T10   |                     | <b>AS98□AP-T10</b>   | ASM98□A-T10   |              |
|                    | <b>AS98□A-T20</b>   | ASM98□A-T20   | ASD30C-A            | <b>AS98□AP-T20</b>   | ASM98□A-T20   | ASD30C-AP    |
| <b>AS98□A-T30</b>  | ASM98□A-T30         | ASD13A-A      | <b>AS98□AP-T30</b>  | ASM98□A-T30          | ASD13A-AP     |              |
| <b>AS46□A-N7.2</b> | ASM46□A-N7.2        |               | <b>AS46□AP-N7.2</b> | ASM46□A-N7.2         |               |              |
| <b>AS46□A-N10</b>  | ASM46□A-N10         |               | <b>AS46□AP-N10</b>  | ASM46□A-N10          |               |              |
| <b>AS66□A-N5</b>   | ASM66□A-N5          |               | <b>AS66□AP-N5</b>   | ASM66□A-N5           |               |              |
| PN Geared          | <b>AS66□A-N7.2</b>  | ASM66□A-N7.2  | ASD24A-A            | <b>AS66□AP-N7.2</b>  | ASM66□A-N7.2  | ASD24A-AP    |
|                    | <b>AS66□A-N10</b>   | ASM66□A-N10   | ASD24B-A            | <b>AS66□AP-N10</b>   | ASM66□A-N10   | ASD24B-AP    |
|                    | <b>AS66□A-N25</b>   | ASM66□A-N25   |                     | <b>AS66□AP-N25</b>   | ASM66□A-N25   |              |
|                    | <b>AS66□A-N36</b>   | ASM66□A-N36   | ASD24C-A            | <b>AS66□AP-N36</b>   | ASM66□A-N36   | ASD24C-AP    |
|                    | <b>AS66□A-N50</b>   | ASM66□A-N50   | ASD30A-A            | <b>AS66□AP-N50</b>   | ASM66□A-N50   | ASD30A-AP    |
|                    | <b>AS98□A-N5</b>    | ASM98□A-N5    |                     | <b>AS98□AP-N5</b>    | ASM98□A-N5    |              |
|                    | <b>AS98□A-N7.2</b>  | ASM98□A-N7.2  |                     | <b>AS98□AP-N7.2</b>  | ASM98□A-N7.2  |              |
|                    | <b>AS98□A-N10</b>   | ASM98□A-N10   |                     | <b>AS98□AP-N10</b>   | ASM98□A-N10   |              |
|                    | <b>AS98□A-N25</b>   | ASM98□A-N25   | ASD30B-A            | <b>AS98□AP-N25</b>   | ASM98□A-N25   | ASD30B-AP    |
|                    | <b>AS98□A-N36</b>   | ASM98□A-N36   |                     | <b>AS98□AP-N36</b>   | ASM98□A-N36   |              |
| HG Geared          | <b>AS46□A2-H50</b>  | ASM46□A2-H50  | ASD13A-A            | <b>AS46□AP2-H50</b>  | ASM46□A2-H50  | ASD13A-AP    |
|                    | <b>AS46□A2-H100</b> | ASM46□A2-H100 | ASD24B-A            | <b>AS46□AP2-H100</b> | ASM46□A2-H100 | ASD24B-AP    |
|                    | <b>AS66□A2-H50</b>  | ASM66□A2-H50  |                     | <b>AS66□AP2-H50</b>  | ASM66□A2-H50  |              |
|                    | <b>AS66□A2-H100</b> | ASM66□A2-H100 | ASD24C-A            | <b>AS66□AP2-H100</b> | ASM66□A2-H100 | ASD24C-AP    |
|                    | <b>AS98□A-H50</b>   | ASM98□A-H50   | ASD30B-A            | <b>AS98□AP-H50</b>   | ASM98□A-H50   | ASD30B-AP    |
|                    | <b>AS98□A-H100</b>  | ASM98□A-H100  |                     | <b>AS98□AP-H100</b>  | ASM98□A-H100  |              |

● Enter **A** (Standard) or **M** (electromagnetic brake) in the box (□) within the model numbers.

### Single-Phase 200-230 VAC

| Type     | AS             |             |              | AS PLUS         |             |              |
|----------|----------------|-------------|--------------|-----------------|-------------|--------------|
|          | Package Model  | Motor Model | Driver Model | Package Model   | Motor Model | Driver Model |
| Standard | <b>AS66□C</b>  | ASM66□C     | ASD12A-C     | <b>AS66□CP</b>  | ASM66□C     | ASD12A-CP    |
|          | <b>AS69□C</b>  | ASM69□C     | ASD16D-C     | <b>AS69□CP</b>  | ASM69□C     | ASD16D-CP    |
|          | <b>AS98□C</b>  | ASM98□C     | ASD16A-C     | <b>AS98□CP</b>  | ASM98□C     | ASD16A-CP    |
|          | <b>AS911AC</b> | ASM911AC    | ASD20A-C     | <b>AS911ACP</b> | ASM911AC    | ASD20A-CP    |

● Enter **A** (Standard) or **M** (electromagnetic brake) in the box (□) within the model numbers.



### ● Single-Phase 200-230 VAC

| Type       | AS            |               |              | AS PLUS       |               |              |
|------------|---------------|---------------|--------------|---------------|---------------|--------------|
|            | Package Model | Motor Model   | Driver Model | Package Model | Motor Model   | Driver Model |
| TH Geared  | AS66□C-T3.6   | ASM66□C-T3.6  | ASD12B-C     | AS66□CP-T3.6  | ASM66□C-T3.6  | ASD12B-CP    |
|            | AS66□C-T7.2   | ASM66□C-T7.2  |              | AS66□CP-T7.2  | ASM66□C-T7.2  |              |
|            | AS66□C-T10    | ASM66□C-T10   | ASD12C-C     | AS66□CP-T10   | ASM66□C-T10   | ASD12C-CP    |
|            | AS66□C-T20    | ASM66□C-T20   |              | AS66□CP-T20   | ASM66□C-T20   |              |
|            | AS66□C-T30    | ASM66□C-T30   | ASD16A-C     | AS66□CP-T30   | ASM66□C-T30   | ASD16A-CP    |
|            | AS98□C-T3.6   | ASM98□C-T3.6  |              | AS98□CP-T3.6  | ASM98□C-T3.6  |              |
|            | AS98□C-T7.2   | ASM98□C-T7.2  |              | AS98□CP-T7.2  | ASM98□C-T7.2  |              |
|            | AS98□C-T10    | ASM98□C-T10   |              | AS98□CP-T10   | ASM98□C-T10   |              |
| AS98□C-T20 | ASM98□C-T20   | ASD16C-C      | AS98□CP-T20  | ASM98□C-T20   | ASD16C-CP     |              |
| AS98□C-T30 | ASM98□C-T30   |               | AS98□CP-T30  | ASM98□C-T30   |               |              |
| PN Geared  | AS66□C-N5     | ASM66□C-N5    | ASD12A-C     | AS66□CP-N5    | ASM66□C-N5    | ASD12A-CP    |
|            | AS66□C-N7.2   | ASM66□C-N7.2  |              | AS66□CP-N7.2  | ASM66□C-N7.2  |              |
|            | AS66□C-N10    | ASM66□C-N10   | ASD12B-C     | AS66□CP-N10   | ASM66□C-N10   | ASD12B-CP    |
|            | AS66□C-N25    | ASM66□C-N25   |              | AS66□CP-N25   | ASM66□C-N25   |              |
|            | AS66□C-N36    | ASM66□C-N36   | ASD12C-C     | AS66□CP-N36   | ASM66□C-N36   | ASD12C-CP    |
|            | AS66□C-N50    | ASM66□C-N50   |              | AS66□CP-N50   | ASM66□C-N50   |              |
|            | AS98□C-N5     | ASM98□C-N5    | ASD16A-C     | AS98□CP-N5    | ASM98□C-N5    | ASD16A-CP    |
|            | AS98□C-N7.2   | ASM98□C-N7.2  |              | AS98□CP-N7.2  | ASM98□C-N7.2  |              |
|            | AS98□C-N10    | ASM98□C-N10   |              | AS98□CP-N10   | ASM98□C-N10   |              |
|            | AS98□C-N25    | ASM98□C-N25   |              | AS98□CP-N25   | ASM98□C-N25   |              |
| AS98□C-N36 | ASM98□C-N36   | ASD16B-C      | AS98□CP-N36  | ASM98□C-N36   | ASD16B-CP     |              |
| AS98□C-N50 | ASM98□C-N50   |               | AS98□CP-N50  | ASM98□C-N50   |               |              |
| HG Geared  | AS66□C2-H50   | ASM66□C2-H50  | ASD12B-C     | AS66□CP2-H50  | ASM66□C2-H50  | ASD12B-CP    |
|            | AS66□C2-H100  | ASM66□C2-H100 | ASD12C-C     | AS66□CP2-H100 | ASM66□C2-H100 | ASD12C-CP    |
|            | AS98□C-H50    | ASM98□C-H50   | ASD16B-C     | AS98□CP-H50   | ASM98□C-H50   | ASD16B-CP    |
|            | AS98□C-H100   | ASM98□C-H100  |              | AS98□CP-H100  | ASM98□C-H100  |              |

● Enter **A** (Standard) or **M** (electromagnetic brake) in the box (□) within the model numbers.

### ● Three-Phase 200-230 VAC

| Type       | AS            |               |              | AS PLUS       |               |              |
|------------|---------------|---------------|--------------|---------------|---------------|--------------|
|            | Package Model | Motor Model   | Driver Model | Package Model | Motor Model   | Driver Model |
| Standard   | AS66□S        | ASM66□C       | ASD12A-S     | AS66□SP       | ASM66□C       | ASD12A-SP    |
|            | AS69□S        | ASM69□C       | ASD16D-S     | AS69□SP       | ASM69□C       | ASD16D-SP    |
|            | AS98□S        | ASM98□C       | ASD16A-S     | AS98□SP       | ASM98□C       | ASD16A-SP    |
|            | AS911AS       | ASM911AC      | ASD20A-S     | AS911ASP      | ASM911AC      | ASD20A-SP    |
| TH Geared  | AS66□S-T3.6   | ASM66□C-T3.6  | ASD12B-S     | AS66□SP-T3.6  | ASM66□C-T3.6  | ASD12B-SP    |
|            | AS66□S-T7.2   | ASM66□C-T7.2  |              | AS66□SP-T7.2  | ASM66□C-T7.2  |              |
|            | AS66□S-T10    | ASM66□C-T10   | ASD12C-S     | AS66□SP-T10   | ASM66□C-T10   | ASD12C-SP    |
|            | AS66□S-T20    | ASM66□C-T20   |              | AS66□SP-T20   | ASM66□C-T20   |              |
|            | AS66□S-T30    | ASM66□C-T30   | ASD16A-S     | AS66□SP-T30   | ASM66□C-T30   | ASD16A-SP    |
|            | AS98□S-T3.6   | ASM98□C-T3.6  |              | AS98□SP-T3.6  | ASM98□C-T3.6  |              |
|            | AS98□S-T7.2   | ASM98□C-T7.2  |              | AS98□SP-T7.2  | ASM98□C-T7.2  |              |
|            | AS98□S-T10    | ASM98□C-T10   |              | AS98□SP-T10   | ASM98□C-T10   |              |
| AS98□S-T20 | ASM98□C-T20   | ASD16C-S      | AS98□SP-T20  | ASM98□C-T20   | ASD16C-SP     |              |
| AS98□S-T30 | ASM98□C-T30   |               | AS98□SP-T30  | ASM98□C-T30   |               |              |
| PN Geared  | AS66□S-N5     | ASM66□C-N5    | ASD12A-S     | AS66□SP-N5    | ASM66□C-N5    | ASD12A-SP    |
|            | AS66□S-N7.2   | ASM66□C-N7.2  |              | AS66□SP-N7.2  | ASM66□C-N7.2  |              |
|            | AS66□S-N10    | ASM66□C-N10   | ASD12B-S     | AS66□SP-N10   | ASM66□C-N10   | ASD12B-SP    |
|            | AS66□S-N25    | ASM66□C-N25   |              | AS66□SP-N25   | ASM66□C-N25   |              |
|            | AS66□S-N36    | ASM66□C-N36   | ASD12C-S     | AS66□SP-N36   | ASM66□C-N36   | ASD12C-SP    |
|            | AS66□S-N50    | ASM66□C-N50   |              | AS66□SP-N50   | ASM66□C-N50   |              |
|            | AS98□S-N5     | ASM98□C-N5    | ASD16A-S     | AS98□SP-N5    | ASM98□C-N5    | ASD16A-SP    |
|            | AS98□S-N7.2   | ASM98□C-N7.2  |              | AS98□SP-N7.2  | ASM98□C-N7.2  |              |
|            | AS98□S-N10    | ASM98□C-N10   |              | AS98□SP-N10   | ASM98□C-N10   |              |
|            | AS98□S-N25    | ASM98□C-N25   |              | AS98□SP-N25   | ASM98□C-N25   |              |
| AS98□S-N36 | ASM98□C-N36   | ASD16B-S      | AS98□SP-N36  | ASM98□C-N36   | ASD16B-SP     |              |
| AS98□S-N50 | ASM98□C-N50   |               | AS98□SP-N50  | ASM98□C-N50   |               |              |
| HG Geared  | AS66□S2-H50   | ASM66□C2-H50  | ASD12B-S     | AS66□SP2-H50  | ASM66□C2-H50  | ASD12B-SP    |
|            | AS66□S2-H100  | ASM66□C2-H100 | ASD12C-S     | AS66□SP2-H100 | ASM66□C2-H100 | ASD12C-SP    |
|            | AS98□S-H50    | ASM98□C-H50   | ASD16B-S     | AS98□SP-H50   | ASM98□C-H50   | ASD16B-SP    |
|            | AS98□S-H100   | ASM98□C-H100  |              | AS98□SP-H100  | ASM98□C-H100  |              |

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