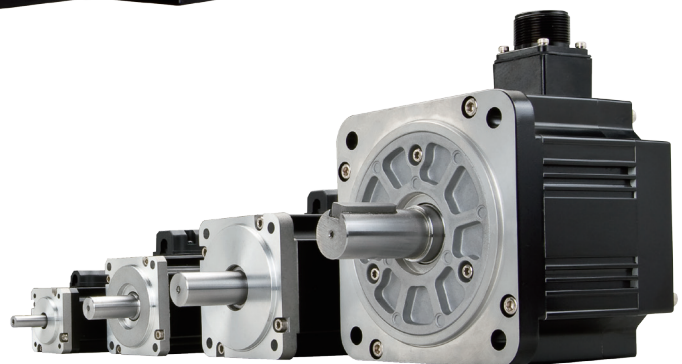


AC Servo Motor & D2 Drive



Technical Information



Linear Motor Stage

Automated transport / AOI application / Precision / Semiconductor

- Iron-core Linear Motor
- Coreless Linear Motor
- Linear Shaft Motor LMT
- Planar Servo Motor
- Air Bearing Platform
- X-Y Stage
- Gantry Systems



Linear Motor

Machine tool / Touch panel industry / Semiconductor industry / Laser manufacturing machine / Glass cutting machine

- Ironcore linear motor-LMFA series, LMSA series, LMSC series
- Ironless linear motor-LMC series, LMT series



Torque Motor (Direct Drive Motor)

Inspection / Testing equipment / Machine tools / Robot

- Rotary Tables-TMS,TMY,TMN
- TMRW Series
- TMRI Series



AC Servo Motor & Drive

Semiconductor / Packaging machine / SMT / Food industry / LCD

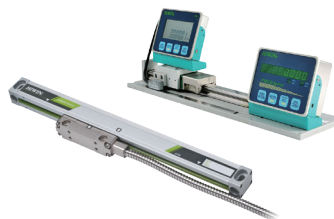
- Drives-D1, D1-N, D2
- Motors-50W~2000W



Linear Actuator

Hospital bed / Automatic window / Home care facility / Riveting / Press-fitting / Surface checks / Bending

- Servo Actuator-LAA series
- LAM series
- LAI series
- LAS series
- LAN series
- LAC series



Positioning Measurement System

Cutting machines / Traditional gantry milling machines / Programmable drilling machines

- High Resolution
- Signal Translator
- High-precision Enclosed
- High Efficiency Counter



Multi Axis Robot

Pick-and-place / Assembly / Array and packaging / Semiconductor / Electro-Optical industry / Automotive industry / Food industry

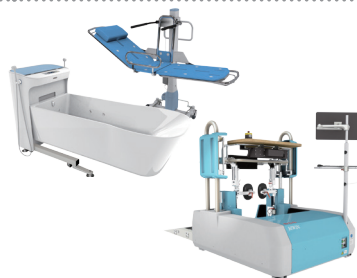
- Articulated Robot
- Delta Robot
- SCARA Robot
- Wafer Robot
- Electric Gripper
- Integrated Electric Gripper
- Rotary Joint



Single Axis Robot

Precision / Semiconductor / Medical / FPD

- KK, SK
- KS, KA
- KU, KE, KC



Medical Equipment

Hospital / Rehabilitation centers / Nursing homes

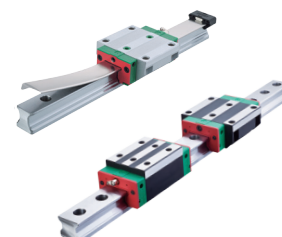
- Robotic Gait Training System
- Hygiene System
- Robotic Endoscope Holder



Ball screw

Precision Ground / Rolled

- Super S series
- Super T series
- Mini Roller
- Ecological & Economical lubrication Module E2
- Rotating Nut (R1)
- Energy-Saving & Thermal-Controlling (C1)
- Heavy Load Series (RD)
- Ball Spline



Linear Guideway

Automation / Semiconductor / Medical

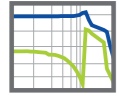
- Ball Type--HG, EG, WE, MG, CG
- Quiet Type--QH, QE, QW, QR
- Other--RG, E2, PG, SE, RC

With High-tech control technology, HIWIN AC Servo motors achieve a great cost-performance ratio for a complete motor drive solution.

| | |
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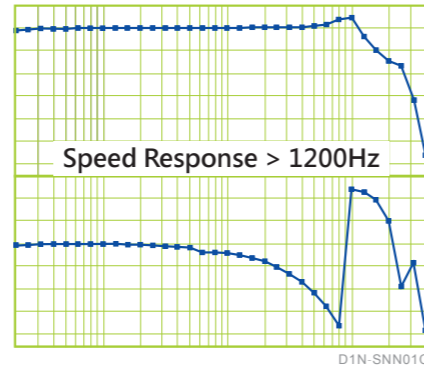
1. Features

Excellent performance



Excellently high speed response

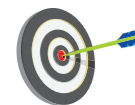
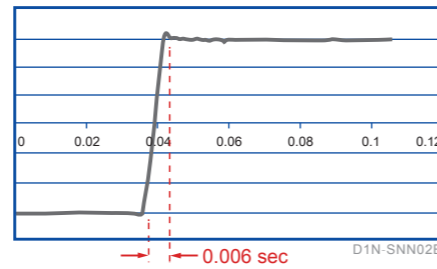
With the help of a semiconductor high-end motion control algorithm and advanced common gain concept, a high speed response is achieved, satisfying all motion control needs.



High acceleration responses

Using advanced controller design tools, and space vector current control technology, high level servo performance is achieved.

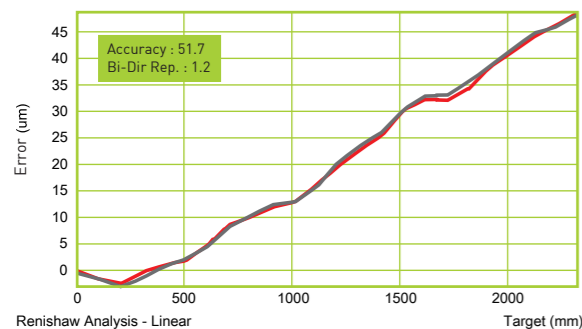
AC servo motor speed can change from -3000 to +3000 rpms in as little as 0.006 seconds.



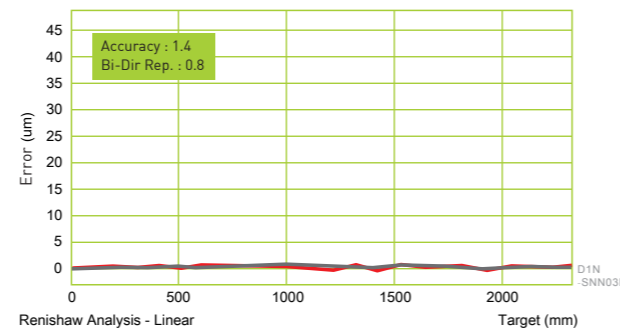
Built-in accuracy improvement feature

The D2 drive includes features to improve total positioning accuracy of the mechanical system.

The table size can be up to 5000 points. It is implemented in all control modes to optimize system behavior.



Without accuracy improvement feature

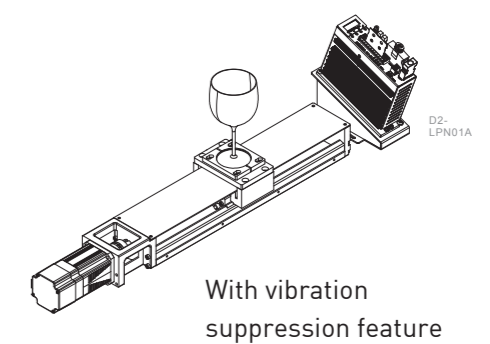
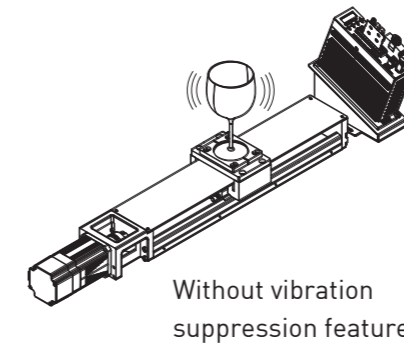


With accuracy improvement feature



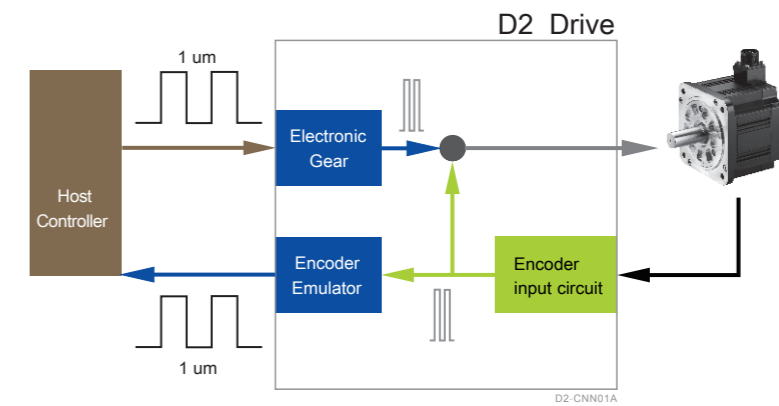
Vibration Suppression Feature

The D2 drive can remove vibration frequency that occurs during movement. It reduces vibrations caused by system's structure and improves the machine's production efficiency.



Electronic gear ratio and Encoder Emulator

The drive can help users adjust pulse resolution for the host controller, and to work with a variety of position encoders with different resolutions; it can also adjust analog position encoder output resolution to the host controller and meet the pulse receiving capability of different host controllers.

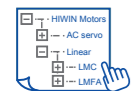
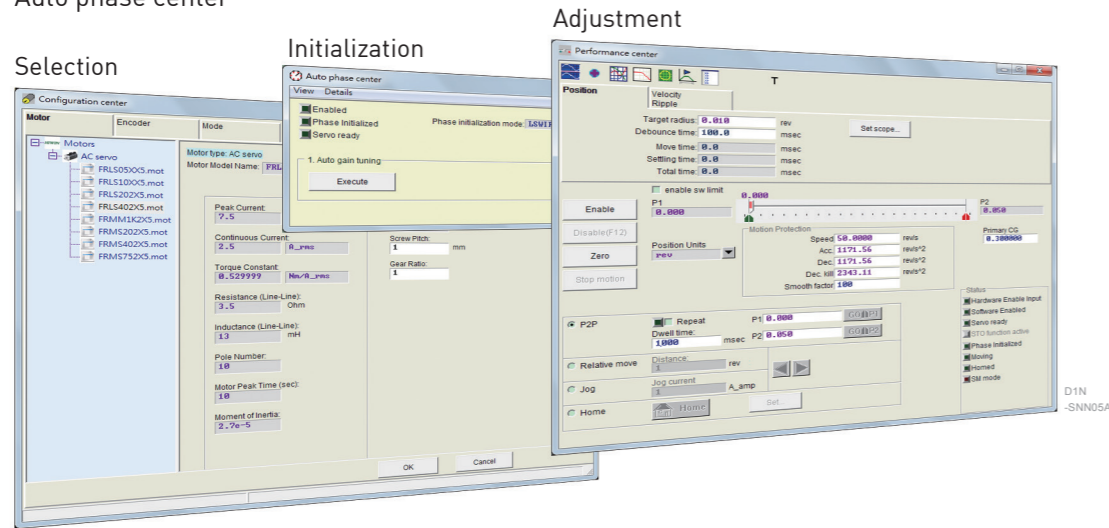


Simple Operation



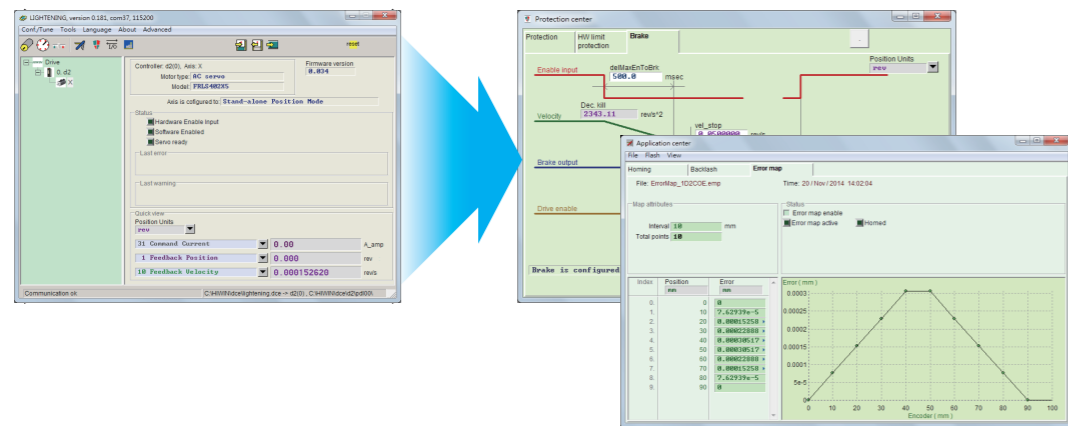
Simple setup

Auto phase center



Easy Operation

Parameters are categorized according to features. Only necessary parameters are shown. No confusing parameter list.



LCD Display

No need to connect to a PC to complete all of the settings and operations. LCD display provides instant status monitoring and displays error messages. Gain and test running can be quickly set by panel keys.



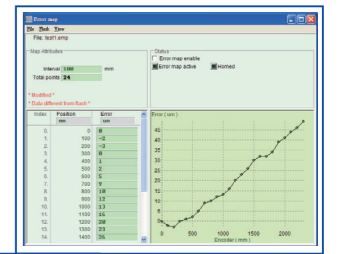
Complete tool sets

Real-time scope, accuracy enhancement function, frequency analysis tools, gain scheduling tool, analysis tool, I/O setting functions, encoder output ratio adjustment function, Z phase signal width adjustment function, PDL, ZeroTune function and filter.



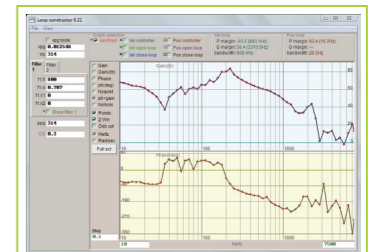
Accuracy enhancement function

To improve on the positioning accuracy of motion systems, the drive amplifier is featured with an error compensation function. By taking the measurements from a laser interferometer, the positioning error table can be built inside the drive, so that high positioning accuracy is achieved.



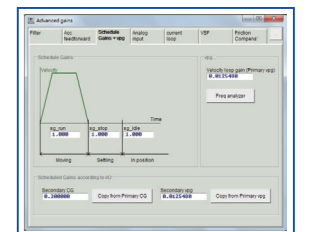
Frequency analysis tools

A powerful and easy to use tool for frequency analysis is provided. You can use the frequency analysis tools to display the real response in the form of a graph. You can easily set the best gain value for the system based on the real response, even first time users can easily get started.



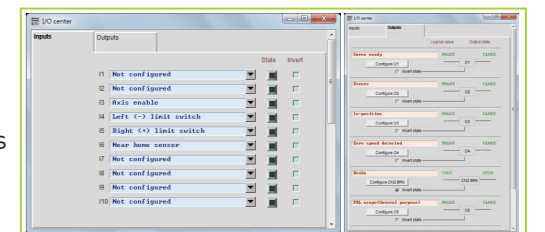
Advanced gain scheduling feature

After setting gains through frequency analysis tools, there is only one value to adjust: the common gain. The drive provides a gain scheduling function. You can adjust the gain according to different phases of motion, such as moving phase, settling phase, and in-position phase.



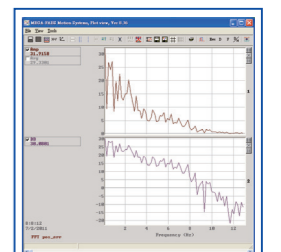
Variety of I / O functions

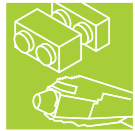
To support a number of different functions, you are free to configure the I/O pin functionality and adapt different hardware interface needs. This satisfies diverse requirements for different motion controllers with regards to their pin assignments and hardware interfaces.



Analysis Tools

To solve a resonance problem, the drive offers a filter design tool for improving the control performance, a Fast Fourier Transform (FFT) and other mathematical operation tools. You can use the functions to calculate the resonant frequency of the system easily, and to make the filter design more accurate.

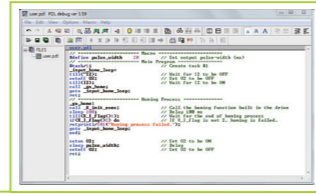




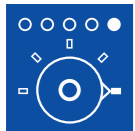
PDL (Process Description Language)

Easy-use process description language is provided.

Complex motions can be designated via PDL, such as extrusion process, point-to-point motion, fixed speed control, homing process and so on. PDL gains the advantages of flexibility and programmability. For quick learning, a number of sample programs are provided in the PDL manual.



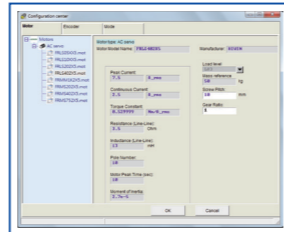
D2-SNN04A



ZeroTune function

Servo loop gains can be easily set without complex procedures via ZeroTune.

Only by selecting the load level of the motor, will stable velocity response be achieved. Even a beginner who has no knowledge of servo control can easily drive a motor.



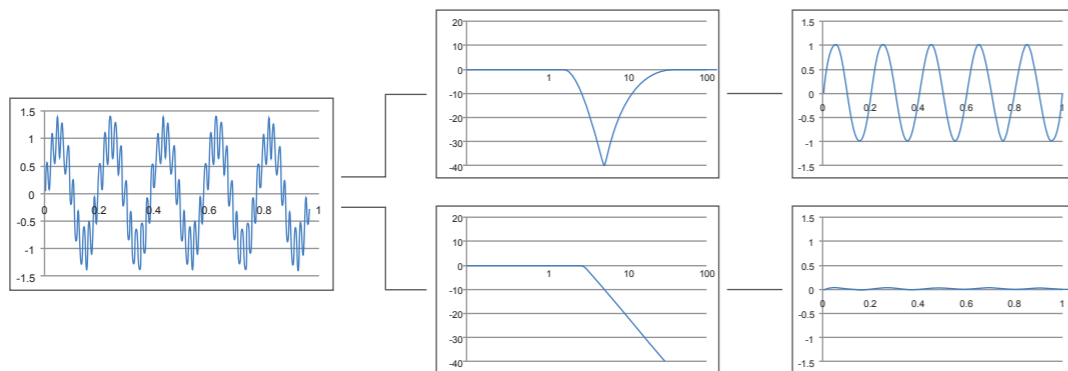
D2-SNN05A



Filter

Drive supports two sets of bi-quad filters.

According to filter parameters, the bi-quad filters can be transformed into different filter types, such as low-pass filter, notch filter, ..., etc. Through well-defined filters, stage vibration can be easily suppressed, and control accuracy can be significantly increased.



Easy integration



A complete solution with positioning module, motor and drive

In addition to providing motor and drive, a variety of linear positioning modules are provided. We provide customers with integrated services and a total solution.



High-speed network communications interface

The D2 is equipped with Industrial Ethernet communications (EtherCAT) interface, and also supports CoE (CANopen over EtherCAT) servo drive protocol. For of multi-axis control, it provides simple wiring, low cost, noise immunity, remote and distributed control needs.



Simple and robust communication interface

Equipped with Modbus communication, D-series drives support Modbus over serial lines (Modbus RTU and Modbus ASCII). On the application of automation, the motor position and velocity can be easily shown on the HMI via Modbus.

2. Safety Certification

2.1 RoHS compliant

Components and finished product all meet RoHS(Restriction of Hazardous Substances Regulation) requirements which ensure the compliance to relevant laws of quality of goods.



RoHS regulations limit six hazardous substances are: Lead (Pb), mercury (Hg), hexavalent chromium (Cr6 +), Polybrominated Biphenyls (PBB), the maximum allowable content of Polybrominated diphenyl ethers (PBDE) is 0.1% (1000ppm), Cadmium (Cd) is 0.01% (100ppm).

2.2 Comply with CE & UL regulations

| | | Drive | Motor |
|---------------------|------------------------|--|---------------------------------------|
| CE Directives CE | EMC Directives | EMC: EN61800-3 EN55011 EN61000-6-2 EN61000-6-4 EN61000-2-4 IEC60146-1-1 IEC61000-2-1 | EN55011 EN61000-6-2 EN61000-6-4 |
| | Low-Voltage Directives | LVDS:EN61800-5-1 | EN60034-1 EN60034-5 |
| UL Directives | | UL:E348161 (D2T 100W/400W/1000W) | UL1004-1 UL1004-6 |

3. Model Descriptions

3.1 Servo drive

| Code | 1 | 2 | 2a | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---------|---|---|----|---|---|---|---|---|---|---|----|----|----|
| Example | D | 2 | T | - | 0 | 4 | 2 | 3 | - | S | - | B | 0 |

Product
 HIWIN servo drive D2 = D2

Type
 17bit encoder only = T
 13bit encoder only = Blank

Rated output
 100W = 01
 400W = 04
 1000W = 10
 2000W = 20

Voltage range
 1/3 phase 220VAC (For A,B,C frame) = 23
 3 phase 220VAC (Only for D frame) = 32

Interface
 Standard = S
 EtherCAT(CoE) = E
 EtherCAT(mega-ulink) = F
 Standard with extension I/O modules = K
 Modbus = T

Frame size
 A frame(suggestion: 100W rated output) = A
 B frame(suggestion: 400W rated output) = B
 C frame(suggestion: 1000W rated output) = C
 D frame(suggestion: 2000W rated output) = D

Encoder type
 13bit less-wire incremental encoder = 0
 17bit serial incremental encoder(HIWIN17) = 4
 Dual Loop (Full closed loop) and 17bit serial absolute encoder = 5

| Model | Interface | Standard | EtherCAT(CoE) | EtherCAT(mega-ulink) | Standard with extension I/O modules | Modbus |
|----------------|-----------|----------|---------------|----------------------|-------------------------------------|--------|
| D2(frame A-C) | | 0 | 0 | 0 | X | 0 |
| D2T(frame A-C) | | 0 | 0 | 0 | △ | X |
| D2T(frame D) | | 0 | 0 | 0 | △ | △ |

0: Available X:Unavailable △:Please contact with Sales Representative.

Note Single and three phase AC voltage drive only support rated output which is lower or equal to 1000W.

3.2 Servo motor

| Code | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---------|---|---|---|---|---|---|---|---|---|----|----|----|
| Example | F | R | L | S | 4 | 0 | 2 | 0 | 6 | 0 | 6 | A |

Product
 HIWIN AC servo motor series = FR

Type
 Low inertia, small capacity(50W~400W) = LS
 Medium inertia, small capacity(50W/100W/400W/750W) = MS
 Medium inertia, medium capacity(1000W/2000W) = MM

Output Power
 50W = 05
 100W = 10
 200W = 20
 400W(Low inertia) = 40
 400W(Medium inertia) = 4B
 750W = 75
 1000W = 1K
 2000W = 2K

Drive input voltage
 220V = 2

Holding brake options
 Without holding brake = 0
 With holding brake = B

Encoder type
 13bit incremental encoder⁽¹⁾ = 5
 17bit absolute encoder = 4
 HIWIN 17 incremental encoder = 6

Frame size
 40mm(MS 50W/100W) = 04
 42mm(LS 50W/100W) = A4
 60 mm(200W/400W) = 06
 80 mm(750W) = 08
 130 mm(1000W/2000W) = 13

Motor shaft
 Round shaft / without oil seal = A
 Round shaft / with oil seal⁽²⁾ = B
 With key and center tap / without oil seal = C
 With key and center tap / with oil seal⁽²⁾ = D

! (1) 13bit only supports FRLS05/10/20/40,FRMS75,FRMM1K
 (2) FRLS 05/10 For the motor with oil seal,please contact Sales Representative

3.3 Motor cable

| Code | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---------|---|---|---|---|---|---|---|---|---|----|----|----|
| Example | H | V | P | S | 0 | 4 | A | A | 0 | 5 | M | B |

Type
HIWIN motor cable = HVP

Capacity
Small capacity (50W~750W) = S
Medium capacity (1000W/2000W) = M

Number of pin
Motor cable without holding brake = 04
Motor cable with holding brake = 06

Motor side connector
AMP connector (50W~750W) = A
Straight waterproof connector (1000W/2000W) = B
L-type waterproof connector (1000W/2000W) = C

Drive side connector
Open cable ends (50W~1000W) = A
R-type terminals (2000W) = B

Cable length
3M = 03M
5M = 05M
7M = 07M
10M = 10M

Cable type
Highly flexible = B

3.4 Encoder cable

| Code | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---------|---|---|---|---|---|---|---|---|---|----|----|----|
| Example | H | V | E | 1 | 7 | I | A | B | 0 | 5 | M | B |

Type
HIWIN encoder cable = HVE

Encoder Type
13bit incremental encoder = 13I
HIWIN 17 incremental encoder = 17I
17bit absolute encoder = 17A

Encoder connector
AMP connector (50W~750W) = A
Straight waterproof connector (1000W/2000W) = B
L-type waterproof connector (1000W/2000W) = C

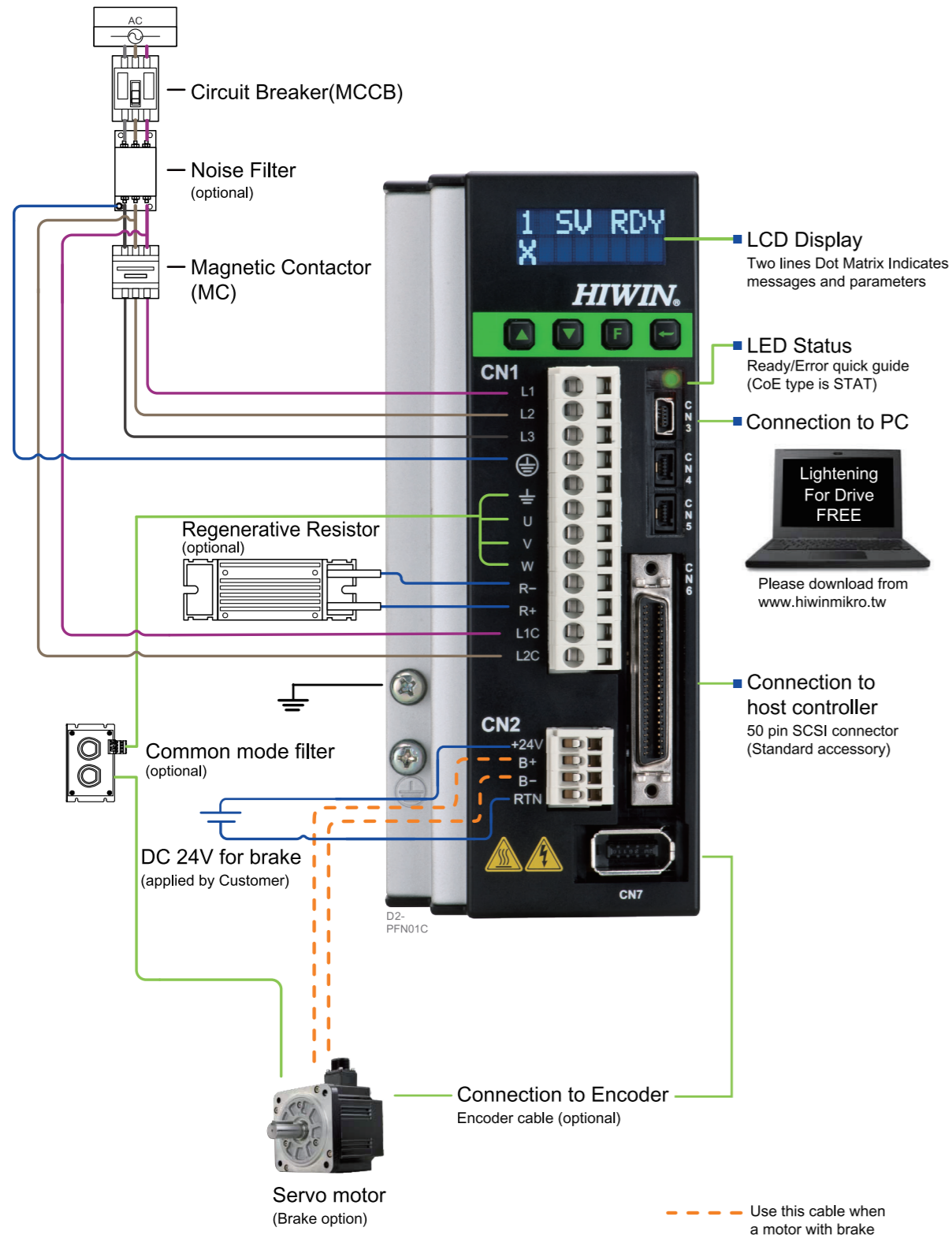
Drive side connector
SCR connector = B

Cable length
3M = 03M
5M = 05M
7M = 07M
10M = 10M

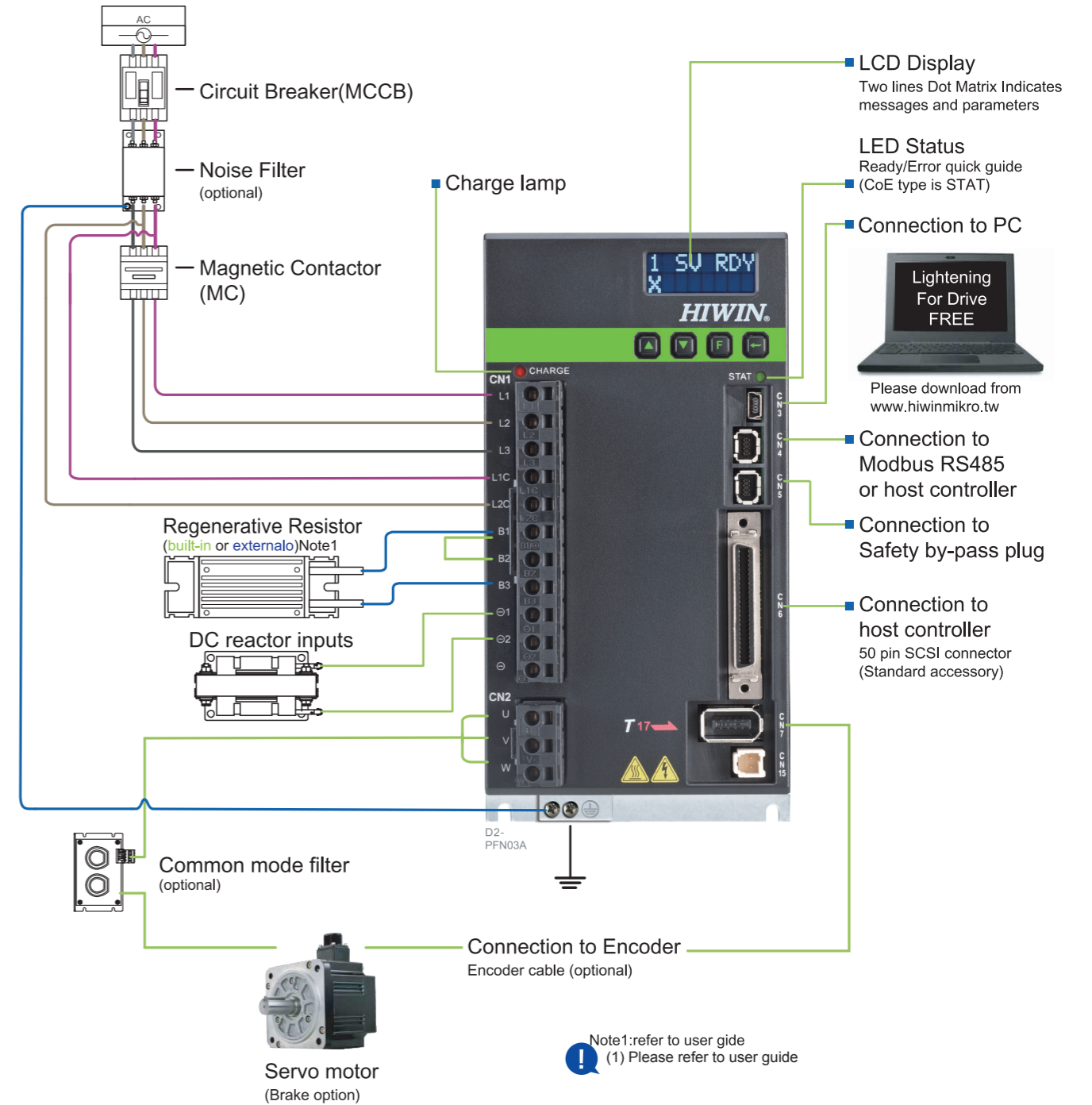
Cable type
Highly flexible = B

4. Interface Directions

4.1 Frame A-C



4.2 Frame D



5. Part numbers and options

| Name | Motor cable | | Encoder cable | Other accessories |
|------------------|---------------|---------------|---------------|---|
| 50W 750W | without brake | | HVPS04AA | HVE13IAB HVE17IAB HVE17AAB |
| | with brake | | HVPS06AA | |
| 1000W | without brake | Straight type | HVPM04BA | HVE13IBB(Straight type) HVE17IBB(Straight type) HVE17ABB(Straight type) HVE13ICB(L-type) HVE17ICB(L-type) HVE17ACB(L-type) |
| | | L-type | HVPM04CA | |
| | with brake | Straight type | HVPM06BA | |
| | | L-type | HVPM06CA | |
| 2000W | without brake | Straight type | HVPM04BB | HVE17IBB(Straight type) HVE17ABB(Straight type) HVE17ICB(L-type) HVE17ACB(L-type) |
| | | L-type | HVPM04CB | |
| | with brake | Straight type | HVPM06BB | |
| | | L-type | HVPM06CB | |
| | | | | Control signal cable: LMACK02D |
| | | | | Single phase EMC Pack: D2-EMC1 or D2-EMC3 |
| | | | | 3 phase EMC Pack: D2-EMC2 |
| | | | | Common mode filter MF-CM-S |
| | | | | DC reactor B86732G15L712 |

! Straight type : straight waterproof connector
L-type : waterproof connector



5.1 AC50W~AC750W – 13bit incremental encoder

| Motor | | | | Drive | | | Optional parts | | | | | | | |
|----------------|--------------|--------------------------------------|-------------------|-------------------------------|--------------|-----------------------------|---------------------|--------------|----------------------------|----------------------|--------------------------------|-------------------------------|--------------------------------|-----|
| Motor Series | Power supply | Output (W) | Part No. (Note 1) | Part No. (Standard interface) | Frame | Power capacity (Rated load) | Motor cable(Note 2) | | Encoder cable | D2 drive accessories | | | | |
| | | | | | | | without brake | with brake | 13bit incremental (Note 2) | Control Signal Cable | Single phase EMC Pack (Note 3) | Three phase EMC Pack (Note 3) | External Regenerative Resistor | |
| Low Inertia | FRLS | single phase/ three phase 220V | 50 | FRLS05205A4△ | D2-0123-S-A0 | Frame A | Approx. 0.4kVA | HVPS04AA□□□B | HVPS06AA□□□B | HVE13IAB□□□B | LMACK02D | D2-EMC1 | D2-EMC2 | N/A |
| | | | | FRLS052B5A4△ | | | | | | | | | | |
| | | | 100 | FRLS10205A4△ | | | | | | | | | | |
| | | | | FRLS102B5A4△ | | | | | | | | | | |
| | | | 200 | FRLS2020506△ | D2-0423-S-B0 | Frame B | Approx. 0.9kVA | | | | | | | |
| | | | | FRLS202B506△ | | | | | | | | | | |
| 400 | FRLS4020506△ | | | | | | | | | | | | | |
| | FRLS402B506△ | | | | | | | | | | | | | |
| Middle inertia | FRMS | 750 | FRMS7520508△ | D2-1023-S-C0 | Frame C | Approx. 1.8kVA | | | | | D2-EMC3 | | RG2 | |
| | | | FRMS752B508△ | | | | | | | | | | | |

Note1 △ : Shaft End & Oil Seal Specification (Please refer to P.9)

Note3 EMC pack model (please refer to P.38)

Note2 Selection of cable / 50W~750W

■ Motor cable / without brake

HVPS04AA □□□ B

Cable length

- 3M.....=03M
- 5M.....=05M
- 7M.....=07M
- 10M.....=10M

Cable type

Highly flexible = B

■ Motor cable and brake cable / with brake

HVPS06AA □□□ B

Cable length

- 3M.....=03M
- 5M.....=05M
- 7M.....=07M
- 10M.....=10M

Cable type

Highly flexible = B

■ Encoder cable / 13bit incremental

HVE13IAB □□□ B

Cable length

- 3M.....=03M
- 5M.....=05M
- 7M.....=07M
- 10M.....=10M

Cable type

Highly flexible = B

! For more information about cables, please refer to P.52-P.58

5.2 AC1000W – 13bit incremental encoder

| Motor | | | | Drive | | Power capacity (Rated load) | Optional parts | | | | | | | |
|----------------|--------------|--------------------------------------|----------------------|----------------------------------|--------------|--------------------------------|---------------------|--------------|-------------------------------|----------------------|-----------------------------------|----------------------------------|--------------------------------|-----|
| Motor Series | Power supply | Output (W) | Part No. (Note 1) | Part No. (Standard interface) | Frame | | Motor cable(Note 2) | | Encoder cable | D2 drive accessories | | | | |
| | | | | | | | without brake | with brake | 13bit incremental (Note 2) | Control Signal Cable | Single phase EMC Pack (Note 3) | Three phase EMC Pack (Note 3) | External Regenerative Resistor | |
| Middle inertia | FRMM | single phase/ three phase 220V | 1000 | FRMM1K20513Δ FRMM1K2B513Δ | D2-1023-S-C0 | Frame C | Approx. 1.8kVA | HVPM04□A□□□B | HVPM06□A□□□B | HVE13I□B□□□B | LMACK02D | D2-EMC3 | D2-EMC2 | RG2 |

Note1 Δ : Shaft End & Oil Seal Specification (Please refer to P.9)

Note3 EMC pack model (please refer to P.38)

Note2 Selection of cable / 1000W

Motor cable / without brake

HVPM04□A□□□ B

Motor side connector
Straight Type=B
L-Shaped Type=C

Cable length
3M.....=03M
5M.....=05M
7M.....=07M
10M.....=10M

Cable type
Highly flexible= B

Motor cable and brake cable / with brake

HVPM06□A□□□ B

Motor side connector
Straight Type=B
L-Shaped Type=C

Cable length
3M.....=03M
5M.....=05M
7M.....=07M
10M.....=10M

Cable type
Highly flexible= B

Encoder cable / 13bit incremental

HVE13I□B□□□ B

Motor side connector
Straight Type=B
L-Shaped Type=C

Cable length
3M.....=03M
5M.....=05M
7M.....=07M
10M.....=10M

Cable type
Highly flexible= B

! For more information about cables, please refer to P.52-P.58

Note5 Medium capacity motor brake power cables are packaged.
Item number HVPM06:
Contains one motor cable and brake cable labeled with HVPM04 and HVPM02.

5.3 AC50W~AC750W – 17bit incremental encoder

| Motor | | | | Drive | | | Optional parts | | | | | | | | |
|----------------|--------------|--------------------------------------|-------------------|-------------------------------|---------------|-----------------------------|---------------------|--------------|----------------------------|----------------------|--------------------------------|-------------------------------|--------------------------------|-----|-----|
| Motor Series | Power supply | Output (W) | Part No. (Note 1) | Part No. (Standard interface) | Frame | Power capacity (Rated load) | Motor cable(Note 2) | | Encoder cable | D2 drive accessories | | | | | |
| | | | | | | | without brake | with brake | 17bit incremental (Note 2) | Control Signal Cable | Single phase EMC Pack (Note 3) | Three phase EMC Pack (Note 3) | External Regenerative Resistor | | |
| Low Inertia | FRLS | single phase/ three phase 220V | 50 | FRLS05206A4Δ | D2T-0123-S-A4 | Frame A | Approx. 0.4kVA | HVPS04AA□□□B | HVPS06AA□□□B | HVE17IAB□□□B | LMACK02D | D2-EMC1 | D2-EMC2 | RG1 | N/A |
| | | | | FRLS052B6A4Δ | | | | | | | | | | | |
| | | | 100 | FRLS10206A4Δ | | | | | | | | | | | |
| | | | | FRLS102B6A4Δ | | | | | | | | | | | |
| | | | 200 | FRLS2020606Δ | D2T-0423-S-B4 | Frame B | | | | | | | | | |
| | | | | FRLS202B606Δ | | | | | | | | | | | |
| 400 | FRLS4020606Δ | | | | | | | | | | | | | | |
| | FRLS402B606Δ | | | | | | | | | | | | | | |
| Middle inertia | FRMS | single phase/ three phase 220V | 50 | FRMS0520604Δ | D2T-0123-S-A4 | Frame A | Approx. 0.4KVA | HVPS04AA□□□B | HVPS06AA□□□B | HVE17IAB□□□B | LMACK02D | D2-EMC3 | D2-EMC2 | RG2 | N/A |
| | | | | FRMS052B604Δ | | | | | | | | | | | |
| | | | 100 | FRMS1020604Δ | | | | | | | | | | | |
| | | | | FRMS102B604Δ | | | | | | | | | | | |
| | | | 400 | FRMS4B20606Δ | D2T-0423-S-B4 | Frame B | | | | | | | | | |
| | | | | FRMS4B2B606Δ | | | | | | | | | | | |
| | | | 750 | FRMS7520608Δ | D2T-1023-S-C4 | Frame C | | | | | | | | | |
| | | | | FRMS752B608Δ | | | | | | | | | | | |

Note1 Δ : Shaft End & Oil Seal Specification (Please refer to P.9)

Note3 EMC pack model (please refer to P.38)

Note2 Selection of cable / 50W~750W

■ Motor cable / without brake

HVPS04AA □□□ B

Cable length

- 3M.....=03M
- 5M.....=05M
- 7M.....=07M
- 10M.....=10M

Cable type

Highly flexible = B

■ Motor cable and brake cable / with brake

HVPS06AA □□□ B

Cable length

- 3M.....=03M
- 5M.....=05M
- 7M.....=07M
- 10M.....=10M

Cable type

Highly flexible = B

■ Encoder cable / 17bit incremental

HVE17IAB □□□ B

Cable length

- 3M.....=03M
- 5M.....=05M
- 7M.....=07M
- 10M.....=10M

Cable type

Highly flexible = B

! For more information about cables, please refer to P.52-P.58

5.4 AC1000W/AC2000W – 17bit incremental encoder

| Motor | | | | Drive | | Power capacity (Rated load) | Optional parts | | | | | | | |
|----------------|--------------|--------------------------------------|----------------------|----------------------------------|-------------------|--------------------------------|---------------------|--------------|-------------------------------|----------------------|-----------------------------------|----------------------------------|--------------------------------|-----|
| Motor Series | Power supply | Output (W) | Part No. (Note 1) | Part No. (Standard interface) | Frame | | Motor cable(Note 2) | | Encoder cable | D2 drive accessories | | | | |
| | | | | | | | without brake | with brake | 17bit incremental (Note 2) | Control Signal Cable | Single phase EMC Pack (Note 3) | Three phase EMC Pack (Note 3) | External Regenerative Resistor | |
| Middle inertia | FRMM | single phase/ three phase 220V | 1000 | FRMM1K20613△ | D2T-1023-S-C4 | Frame C | Approx. 1.8kVA | HVPM04□A□□□B | HVPM06□A□□□B | HVE17I□B□□□B | LMACK02D | D2-EMC3 | D2-EMC2 | RG2 |
| | | | | FRMM1K2B613△ | | | | | | | | | | |
| | 2000 | FRMM2K20613△ | D2T-2032-S-D4 | Frame D | Approx. 3.5kVA | HVPM04□B□□□B | HVPM06□B□□□B | | | | | | | |
| | | | | | | | | FRMM2K2B613△ | | | | | | |

Note1 △ : Shaft End & Oil Seal Specification (Please refer to P.9)

Note3 EMC pack model (please refer to P.38)

Note2 Selection of cable / 1000W, 2000W

■ Motor cable / without brake

HVPM04□ A □□□ B

Motor side connector

Straight Type=B
L-Shaped Type=C

Drive side connector

Open cable ends =A
R-type terminals =B

Cable length

3M.....=03M
5M.....=05M
7M.....=07M
10M.....=10M

Cable type

Highly flexible = B

■ Motor cable and brake cable / with brake

HVPM06□ A □□□ B

Motor side connector

Straight Type=B
L-Shaped Type=C

Drive side connector

Open cable ends =A
R-type terminals =B

Cable length

3M.....=03M
5M.....=05M
7M.....=07M
10M.....=10M

Cable type

Highly flexible = B

■ Encoder cable / 17bit incremental

HVE17I□B□□□ B

Motor side connector

Straight Type=B
L-Shaped Type=C

Cable length

3M.....=03M
5M.....=05M
7M.....=07M
10M.....=10M

Cable type

Highly flexible= B

! For more information about cables, please refer to P.52-P.58

Note5 Medium capacity motor brake power cables are packaged.
Item number HVPM06:
Contains one motor cable and brake cable labeled with HVPM04 and HVPM02.

5.5 AC50W~AC750W – 17bit absolute encoder

| Motor | | | | Drive | | | Optional parts | | | | | | | | |
|----------------|--------------|--------------------------------------|-------------------|-------------------------------|---------------|-----------------------------|---------------------|--------------|-------------------------|----------------------|--------------------------------|-------------------------------|--------------------------------|-----|-----|
| Motor Series | Power supply | Output (W) | Part No. (Note 1) | Part No. (Standard interface) | Frame | Power capacity (Rated load) | Motor cable(Note 2) | | Encoder cable | D2 drive accessories | | | | | |
| | | | | | | | without brake | with brake | 17bit absolute (Note 2) | Control Signal Cable | Single phase EMC Pack (Note 3) | Three phase EMC Pack (Note 3) | External Regenerative Resistor | | |
| Low Inertia | FRLS | single phase/ three phase 220V | 50 | FRLS05204A4Δ | D2T-0123-S-A5 | Frame A | Approx. 0.4KVA | HVPS04AA□□□B | HVPS06AA□□□B | HVE17AAB□□□B | LMACK02D | D2-EMC1 | D2-EMC2 | RG1 | N/A |
| | | | | FRLS052B4A4Δ | | | | | | | | | | | |
| | | | 100 | FRLS10204A4Δ | D2T-0423-S-B5 | Frame B | Approx. 0.9kVA | | | | | | | | |
| | | | | FRLS102B4A4Δ | | | | | | | | | | | |
| | | | 200 | FRLS2020406Δ | D2T-0423-S-B5 | Frame B | Approx. 0.9kVA | | | | | | | | |
| | | | | FRLS202B406Δ | | | | | | | | | | | |
| 400 | FRLS4020406Δ | D2T-0423-S-B5 | Frame B | Approx. 0.9kVA | | | | | | | | | | | |
| | FRLS402B406Δ | | | | | | | | | | | | | | |
| Middle inertia | FRMS | single phase/ three phase 220V | 50 | FRMS0520404Δ | D2T-0123-S-A5 | Frame A | Approx. 0.4KVA | HVPS04AA□□□B | HVPS06AA□□□B | HVE17AAB□□□B | LMACK02D | D2-EMC3 | D2-EMC2 | RG2 | N/A |
| | | | | FRMS052B404Δ | | | | | | | | | | | |
| | | | 100 | FRMS1020404Δ | D2T-0423-S-B5 | Frame B | Approx. 0.9KVA | | | | | | | | |
| | | | | FRMS102B404Δ | | | | | | | | | | | |
| | | | 400 | FRMS4B20406Δ | D2T-0423-S-B5 | Frame B | Approx. 0.9KVA | | | | | | | | |
| | | | | FRMS4B2B406Δ | | | | | | | | | | | |
| 750 | FRMS7520408Δ | D2T-1023-S-C5 | Frame C | Approx. 1.8KVA | | | | | | | | | | | |
| | FRMS752B408Δ | | | | | | | | | | | | | | |

Note1 Δ : Shaft End & Oil Seal Specification (Please refer to P.9)

Note3 EMC pack model (please refer to P.38)

Note2 Selection of cable / 50W~750W

■ Motor cable / without brake

HVPS04AA □□□ B

Cable length

- 3M.....=03M
- 5M.....=05M
- 7M.....=07M
- 10M.....=10M

Cable type

Highly flexible = B

■ Motor cable and brake cable / with brake

HVPS06AA □□□ B

Cable length

- 3M.....=03M
- 5M.....=05M
- 7M.....=07M
- 10M.....=10M

Cable type

Highly flexible = B

■ Encoder cable / 17bit absolute

HVE17AAB □□□ B

Cable length

- 3M.....=03M
- 5M.....=05M
- 7M.....=07M
- 10M.....=10M

Cable type

Highly flexible = B

! For more information about cables, please refer to P.52-P.58

5.6 AC1000W/AC2000W – 17bit absolute encoder

| Motor | | | | Drive | | | Optional parts | | | | | | | |
|----------------|--------------|--------------------------------------|-------------------|-------------------------------|-------------------|-----------------------------|---------------------|--------------|-------------------------|----------------------|--------------------------------|-------------------------------|--------------------------------|-----|
| Motor Series | Power supply | Output (W) | Part No. (Note 1) | Part No. (Standard interface) | Frame | Power capacity (Rated load) | Motor cable(Note 2) | | Encoder cable | D2 drive accessories | | | | |
| | | | | | | | without brake | with brake | 17bit absolute (Note 2) | Control Signal Cable | Single phase EMC Pack (Note 3) | Three phase EMC Pack (Note 3) | External Regenerative Resistor | |
| Middle inertia | FRMM | single phase/ three phase 220V | 1000 | FRMM1K20413△ | D2T-1023-S-C5 | Frame C | Approx. 1.8kVA | HVPM04□A□□□B | HVPM06□A□□□B | HVE17A□B□□□B | LMACK02D | D2-EMC3 | D2-EMC2 | RG2 |
| | | | | FRMM1K2B413△ | | | | | | | | | | |
| | 2000 | FRMM2K20413△ | D2T-2032-S-D5 | Frame D | Approx. 3.5kVA | HVPM04□B□□□B | HVPM06□B□□□B | | | | | | | |
| | | | | | | FRMM2K2B413△ | | | | | | | | |

Note1 △ : Shaft End & Oil Seal Specification (Please refer to P.9)

Note3 EMC pack model (please refer to P.38)

Note2 Selection of cable / 1000W, 2000W

■ Motor cable / without brake

HVPM04□ A □□□ B

Motor side connector

Straight Type=B
L-Shaped Type=C

Drive side connector

Open cable ends =A
R-type terminals =B

Cable length

3M..... =03M
5M..... =05M
7M..... =07M
10M..... =10M

Cable type

Highly flexible = B

■ Motor cable and brake cable / with brake

HVPM06□ A □□□ B

Motor side connector

Straight Type=B
L-Shaped Type=C

Drive side connector

Open cable ends =A
R-type terminals =B

Cable length

3M..... =03M
5M..... =05M
7M..... =07M
10M..... =10M

Cable type

Highly flexible = B

■ Encoder cable / 17bit absolute

HVE17A□B□□□ B

Motor side connector

Straight Type=B
L-Shaped Type=C

Cable length

3M..... =03M
5M..... =05M
7M..... =07M
10M..... =10M

Cable type

Highly flexible = B

! For more information about cables, please refer to P.52-P.58

Note5 Medium capacity motor brake power cables are packaged.
Item number HVPM06:
Contains one motor cable and brake cable labeled with HVPM04 and HVPM02.

6. Servo Drive

6.1 Servo drive with standard interface

Specifications

| | | | | |
|------------------------|----------------|---|---|---|
| Input power | 220V | Main power | Frame A~C | Single/three-phase, 200 to 240V 50/60Hz |
| | | | Frame D | Three-phase, 200-240 Vac 50/60Hz |
| | | Control power | Frame A~D | Single phase, 200 to 240V 50/60Hz |
| Environment | Temperature | | Operation Temperature: 0°C~45°C (If temperature is higher than 45°C, ventilation is needed) Storage Temperature: -20°C~65°C | |
| | Humidity | | 0 to 90%RH (no frost) | |
| | Altitude | | Under 1000 Meters | |
| | Vibration | | 1G (10 to 500Hz) | |
| Control method | | | IGBT PWM space vector control | |
| Encoder feedback | | | 13bit incremental 17bit incremental Dual loop (Full closed loop) and 17bit absolute | |
| I/O signal connector | Control signal | Input | General purpose 9 inputs (D2T:10) | |
| | | Output | General purpose 4 outputs (D2T:5) | |
| | Analog signal | Input | 1 input (12bit A/D) | |
| | | Output | 2 outputs (Analog monitor-under construction) | |
| | Pulse signal | Input | 2 inputs (Low speed channel, High speed channel) | |
| | | Output | 4 outputs (Line drive: 3output, open collector: 1 output) | |
| Brake connector | Control signal | Output | Direct brake connection. (No need of extra relay for brake) Also programmable for general purpose output | |
| Communication function | | USB | Connection with PC, 115200bps | |
| Front panel | | Dot matrix 2*8 characters LCD with 4 buttons LED(green, red) | | |
| Regenerative function | | Frame A-C | Need external connection, no internal regenerative resistor | |
| | | Frame D | Built in or external regenerative resistor (option), 13Ω±5%, continue power 120W, Peak power 600W | |
| Control mode | | Switching among the following modes is possible (1)Position control (2)Velocity control (3)Torque control (4)Position/Velocity control (5)Position/Torque control (6)Velocity/Torque control | | |
| Dynamic brake | | Frame A-C | N/A | |
| | | Frame D | Built in line resistance: 2.6 Ω ± 5%, continuous power: 120 W, peak power: 600 W | |

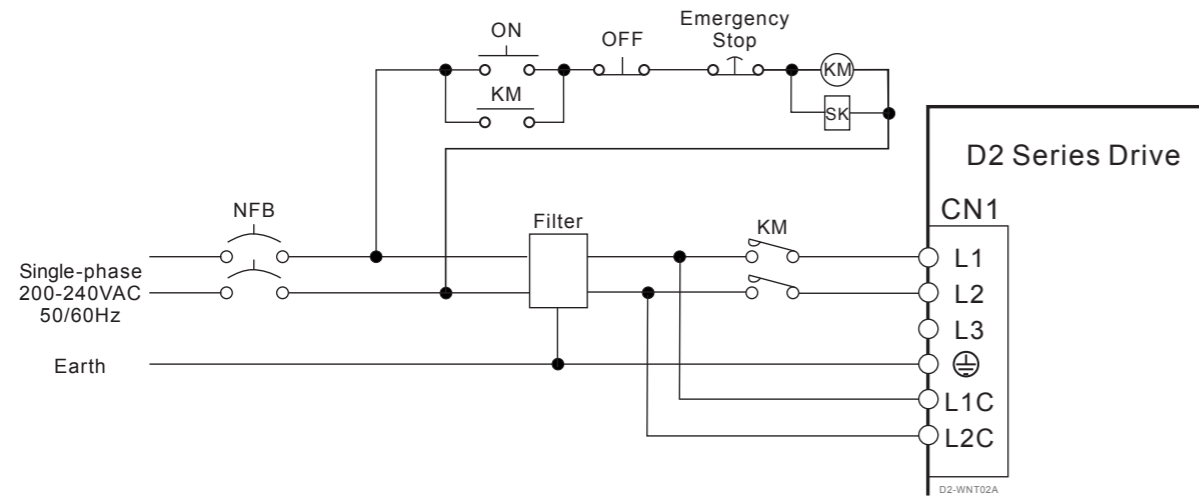
Functions

| | | | |
|-----------------------------------|----------------------|--|---|
| Position control | Control input | | (1)Axis enable; (2)Left and right limit switch; (3)Home OK, start err. map; (4)Reset amplifier; (5)Near home sensor; (6)Clear error; (7)Switch to secondary CG and vpg; (8)Inhibit pulse command; (9)Switch HI/LO pulse input; (10)Abort motion; (11)Switch to secondary mode; (12)Start homing; (13)Electronic gear select (DIV1/DIV2) |
| | Control output | | (1)Brake; (2)Servo ready; (3)Axis disable; (4)In-position; (5)Moving; (6)Homed; (7)Emulated index; (8)Zero speed detected; (9)Errors |
| | Pulse input | Max. command pulse frequency | Dedicated interface for Photo-coupler(single end input): 500kpps Dedicated interface for line drive(differential input): 4Mpps(16M cnt/s with AqB) |
| | | Input pulse signal format | (1)Pulse and Direction (2)Pulse Up/Pulse Down (3)Quadrature(AqB) |
| | | Electronic gear (Division/Multiplication of command pulse) | Gear ratio : pulses/counts pulses : 1~2, 147, 483, 647 counts : 1~2, 147, 483, 647 |
| Smoothing filter | | Smooth factor : 1~500 (0: no smoothing filter) | |
| Vibration suppression filter(VSF) | | VSF can remove the vibration frequency that occurs during movement. It can reduce the vibration caused by the system's structure and improve the machine's productivity. | |
| Velocity control | Control input | | (1)Axis enable; (2)Left and right limit switch; (3)Home OK, start err. map; (4)Reset amplifier; (5)Near home sensor; (6)Clear error; (7)Invert V command; (8)Switch to secondary CG and vpg; (9)Zero speed clamp; (10)Abort motion; (11)Switch to secondary mode |
| | Control output | | (1)Brake; (2)Servo ready; (3)Axis disable; (4)In-position; (5)Moving; (6)Homed; (7)Emulated index; (8)Zero speed detected; (9)Errors |
| | PWM input | Velocity command input | Speed command input can be provided by means of duty cycle of PWM input. Parameter are used for scale setting and command polarity. |
| | Analog Input | Velocity command input | Speed instruction can be set with analog voltage method, parameters can set ratio and direction +/-10V |
| | Zero speed clamp | | Zero speed clamp input is possible. |
| Torque control | Control input | | (1)Axis enable; (2)Left and right limit switch; (3)Home OK, start err. map; (4)Reset amplifier; (5)Near home sensor; (6)Clear error; (7)Invert V command; (8)Switch to secondary CG and vpg; (9)Switch to secondary mode |
| | Control output | | (1)Brake; (2)Servo ready; (3)Axis disable; (4)In-position; (5)Moving; (6)Homed; (7)Emulated index; (8)Zero speed detected; (9)Errors |
| | PWM input | Torque command input | Torque command input can be provided by means of duty cycle of PWM input. Parameter are used for scale setting and command polarity. |
| | Analog Input | Torque command input | Torque command input can be provided by means of analog voltage. Parameter are used for scale setting and command polarity. |
| | Speed limit function | | Speed limit value with parameter is possible |
| ZeroTune | | ZeroTune can find the proper gains by clicking one button on LCD when the motor is disable. | |
| Emulated encoder feedback output | | Set up of any value is possible (frequency up to 18M cnt/s, only frame D drive up to 9M cnt/s) | |
| Protective function | | (1)Motor short detection; (2)Over voltage; (3)Position error too big; (4)Encoder error; (5)Soft thermal threshold reached; (6)Motor maybe disconnect; (7)Amplifier over temperature; (8)Under voltage; (9)5V for encoder card fail; (10)Phase init. error; (11)Serial encoder communication error; (12)Hall sensor error; (13)Current control error; (14)Hybrid deviation too big; (15)HFLT inconsistent error; (16)Incompatible motor model for drive; (17)DC bus voltage abnormal; (18)EtherCAT interface disconnected | |
| Error log | | Errors and warnings are saved in non-volatile memory | |
| Error Mapping | | Method: Established compensation table to compensate encoder error by linear interpolation Samples: Maximum 5,000 point Storage: Flash ROM, Disc file Unit: count Activation: Activated internally by home complete, or activated externally by input signal | |
| Others | | Friction compensation, Backlash compensation | |

6.2 Wiring diagram

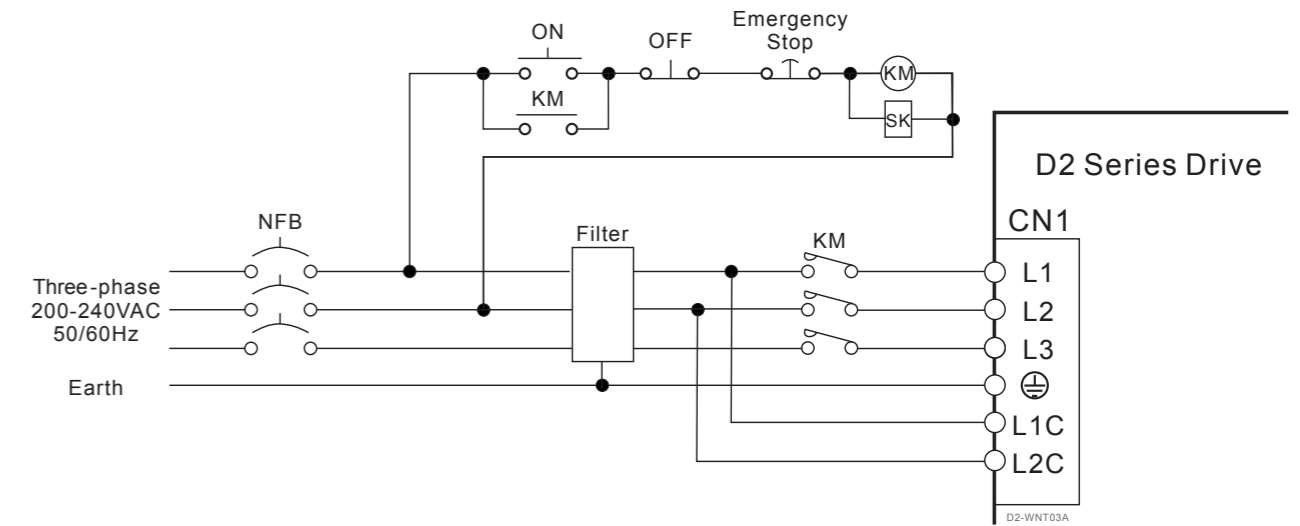
Single-phase

| Recommended models: FN2090-6-06 filter | |
|--|--------------------|
| Maximum continuous operating voltage | 250VAC, 50/60Hz |
| Operating Frequency | DC to 400Hz |
| Rated Current | 6A@40°C |
| Surge pulse protection | 2kV, IEC 61000-4-5 |



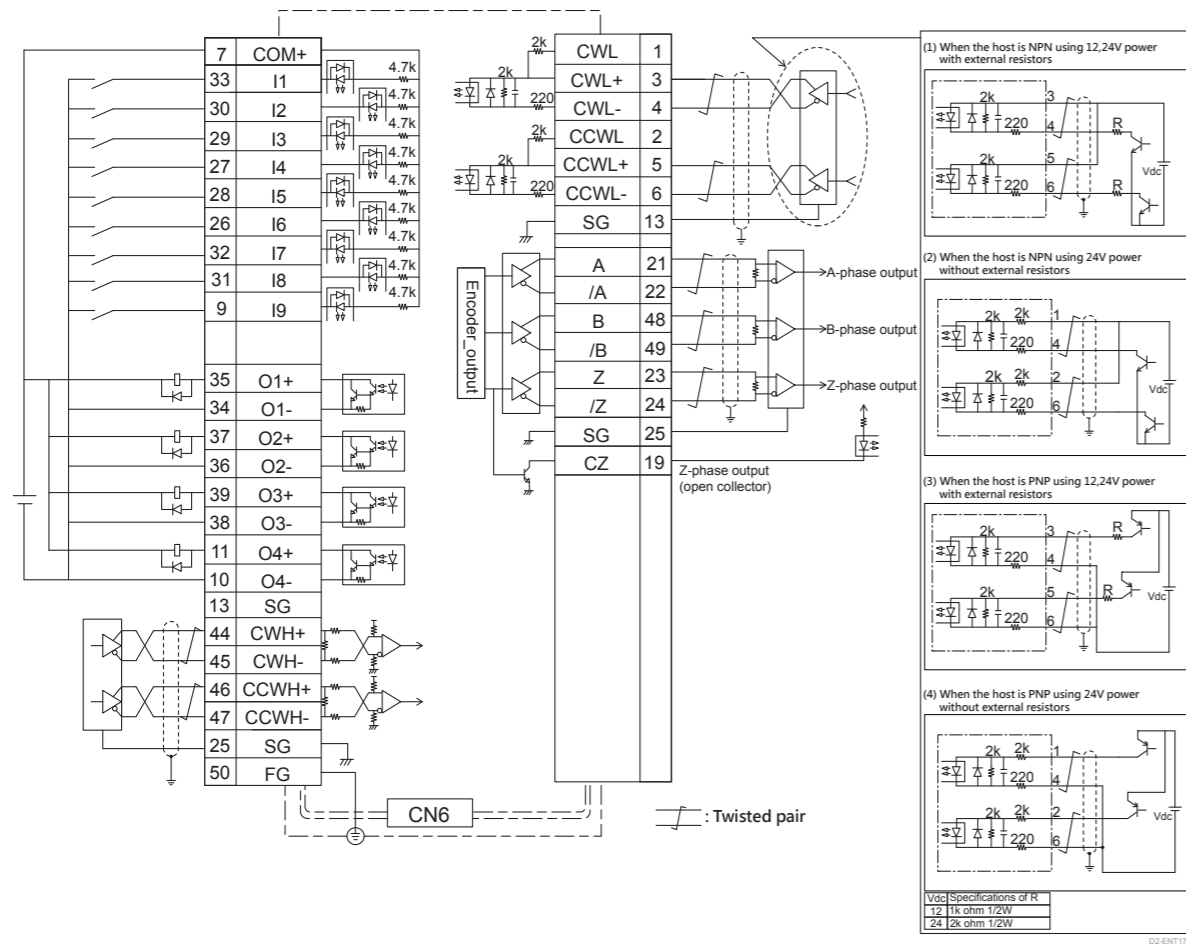
Three-phase

| Recommended models: FN3025L-20-71 filter | |
|--|---------------|
| Maximum continuous operating voltage | 3x520/300 VAC |
| Operating Frequency | DC to 400Hz |
| Rated Current | 20A@50°C |

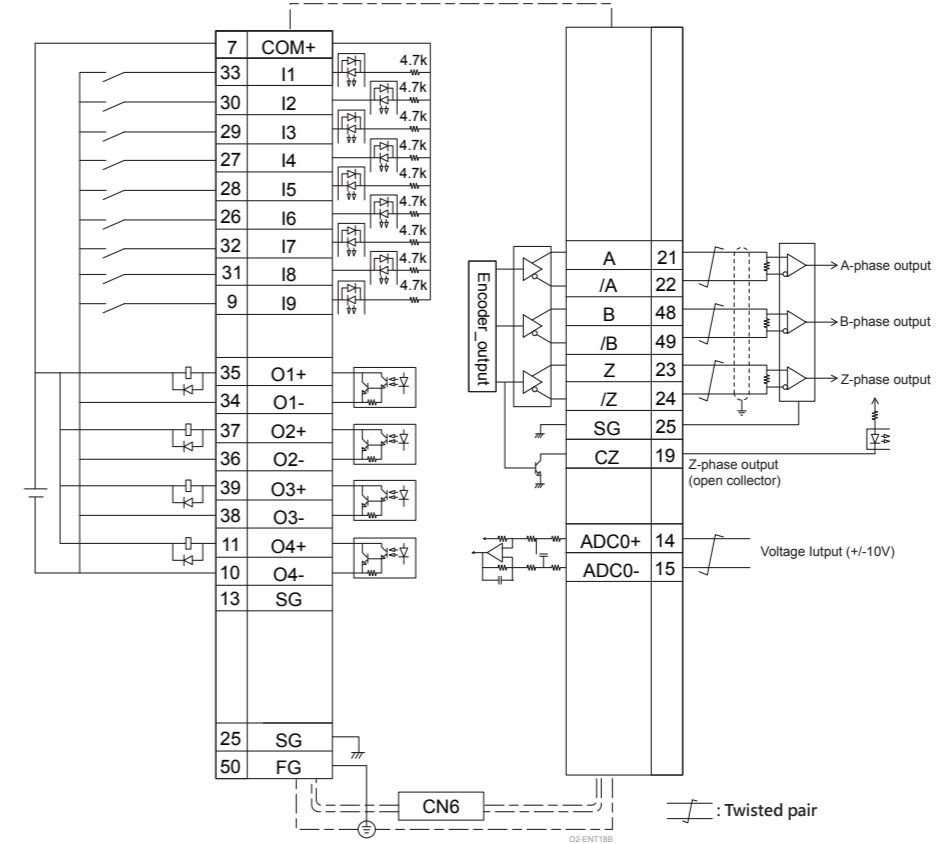


6.3 Control circuit

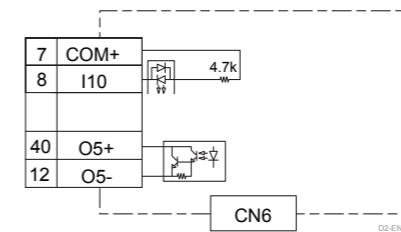
■ Wiring Example of Position Control Mode



■ Wiring Example of Velocity/Torque Control Mode

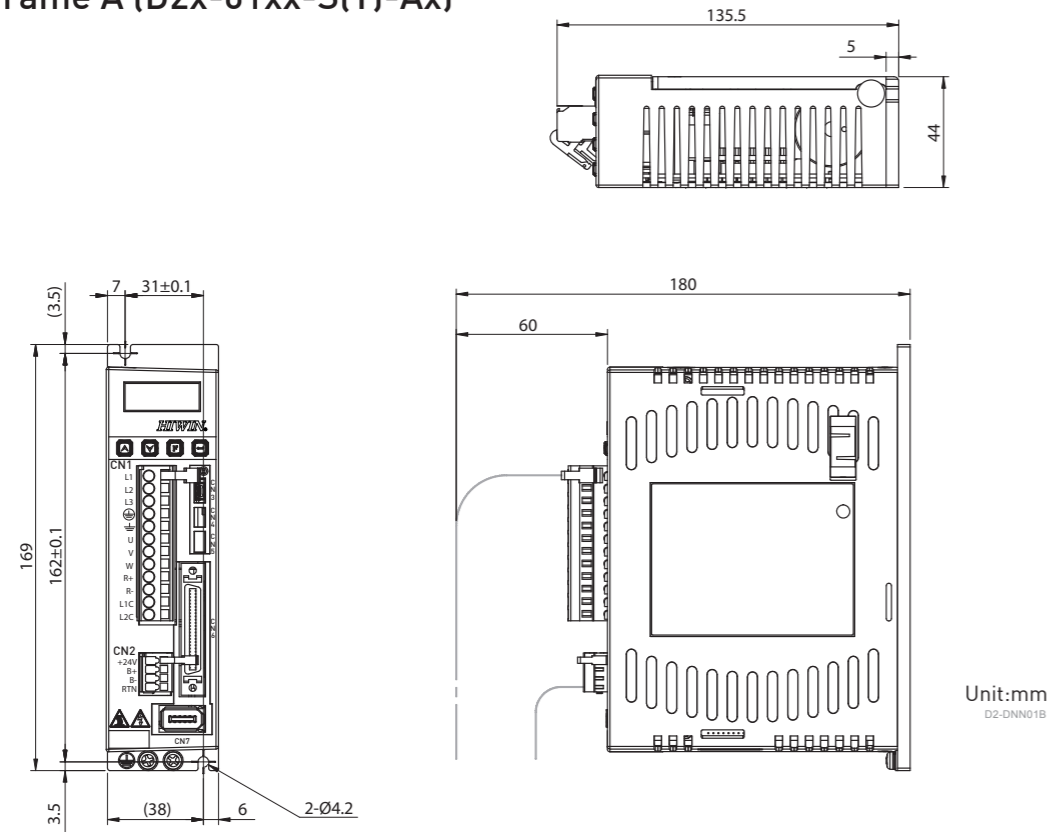


■ Additional I/O pins (Only for D2T drive)

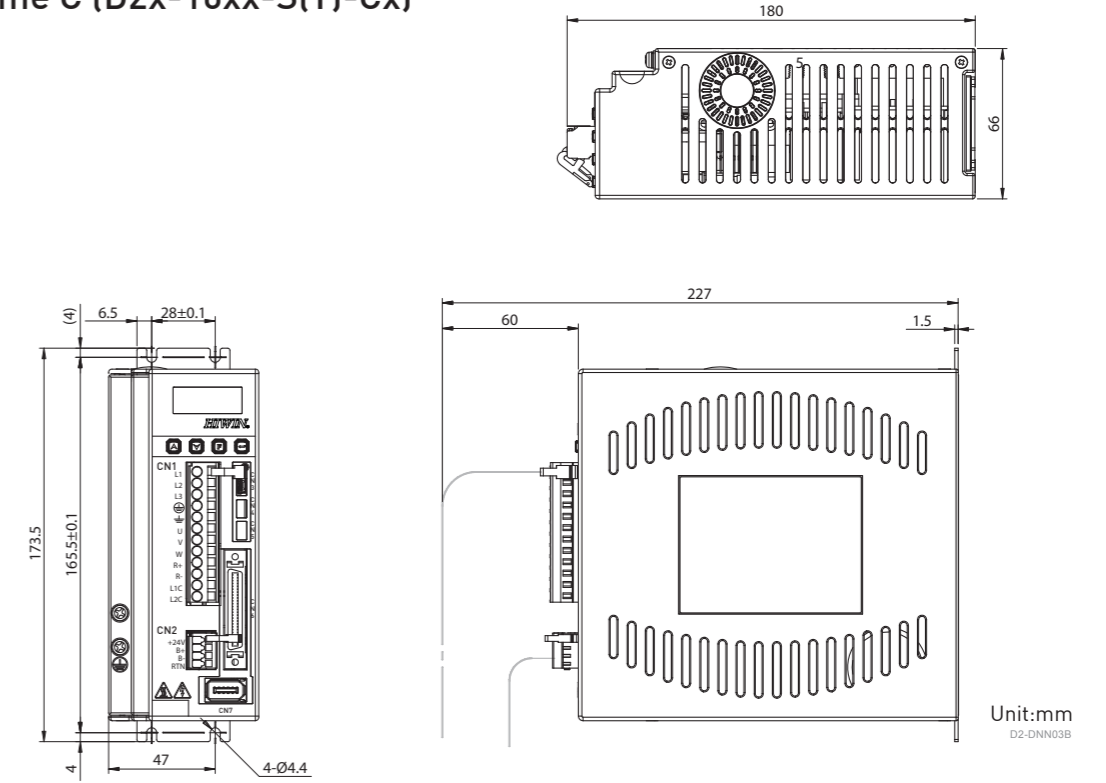


6.4 Dimensions of drive

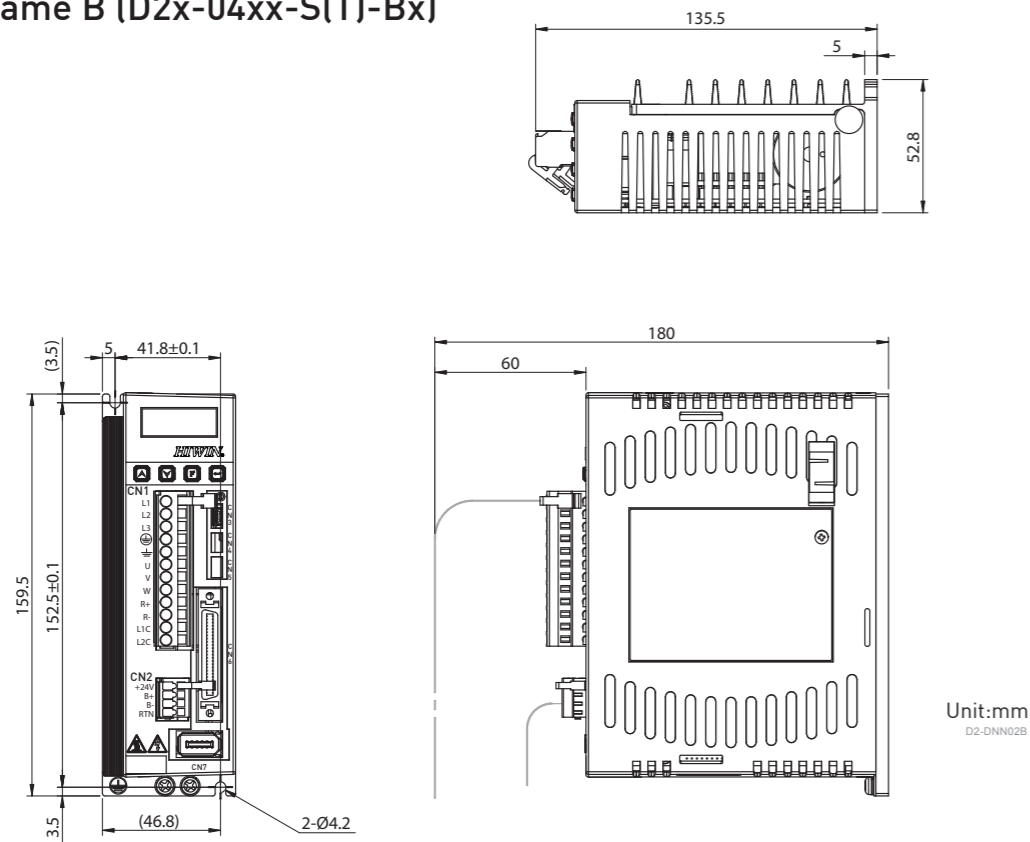
■ Frame A (D2x-01xx-S(T)-Ax)



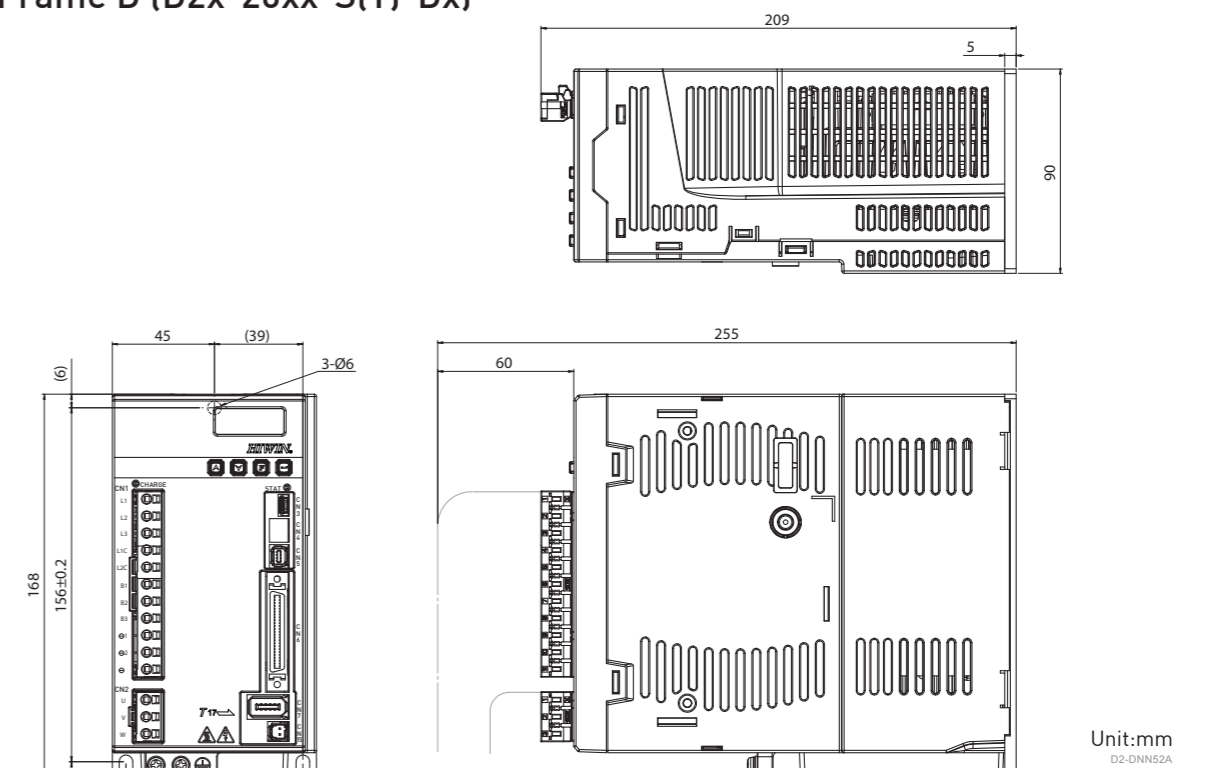
■ Frame C (D2x-10xx-S(T)-Cx)



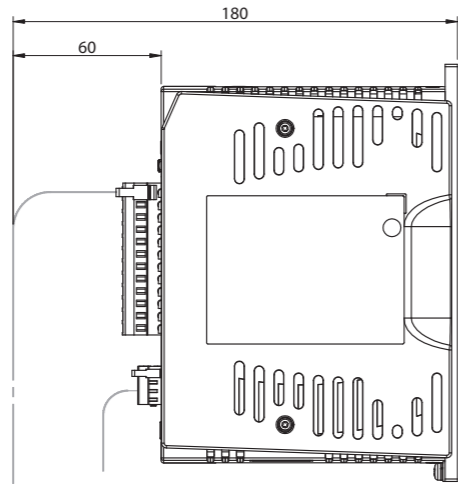
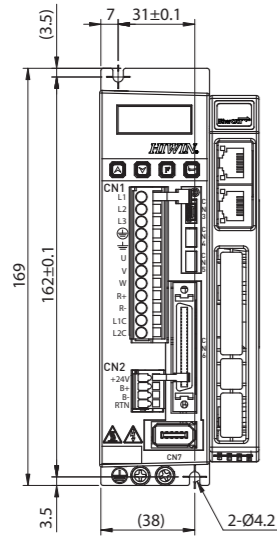
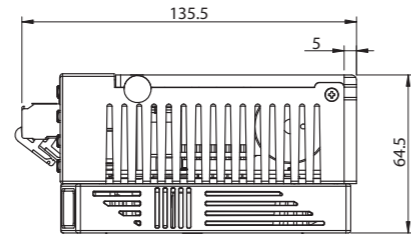
■ Frame B (D2x-04xx-S(T)-Bx)



■ Frame D (D2x-20xx-S(T)-Dx)

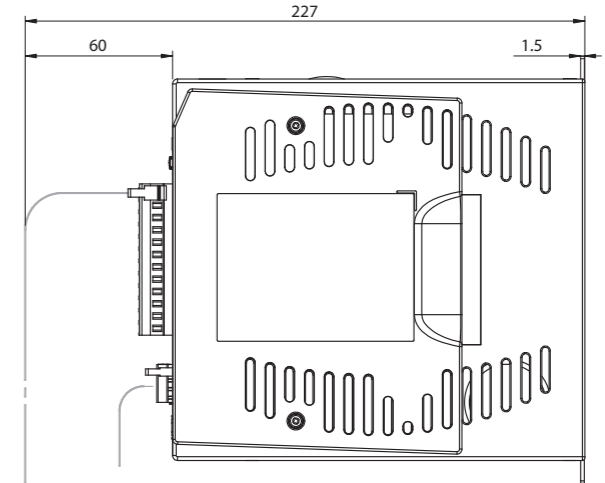
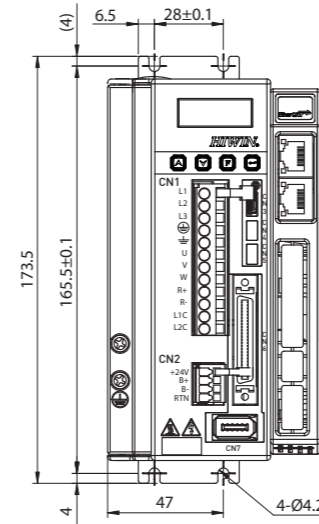
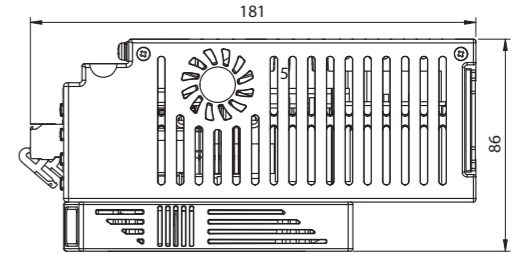


■ Frame A (D2x-01xx-E(Note)-Ax)



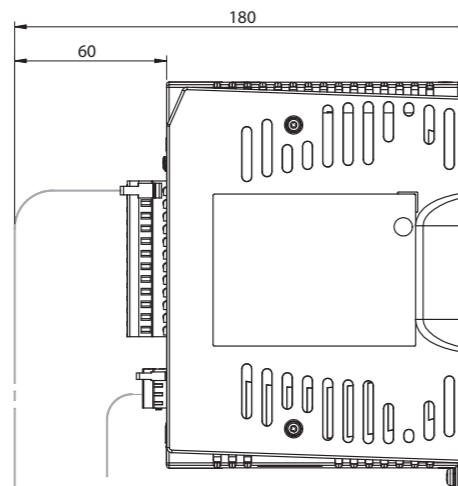
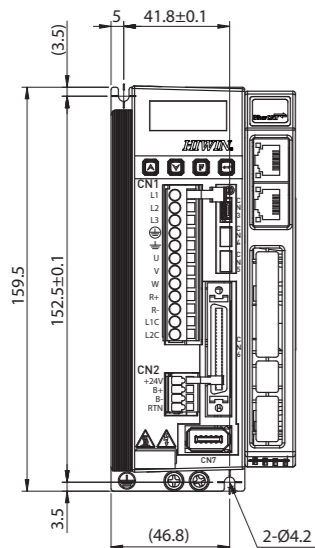
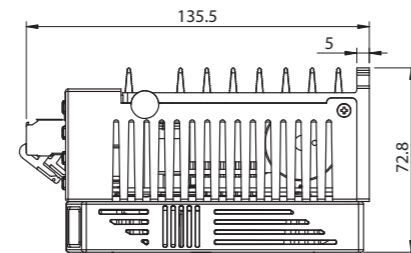
Unit:mm
D2-DNN49B

■ Frame C (D2x-10xx-E(Note)-Cx)



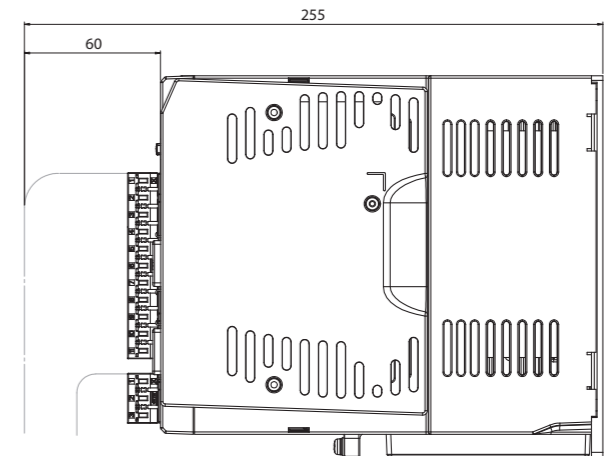
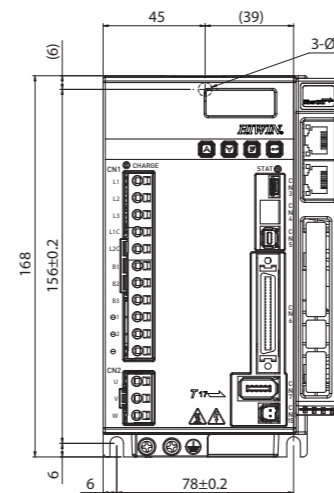
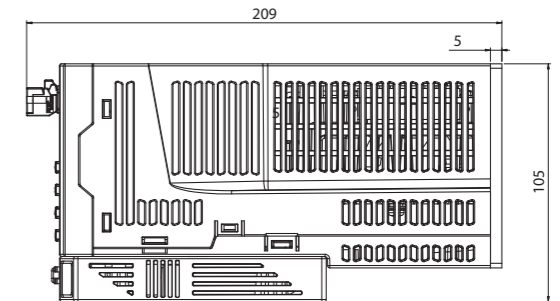
Unit:mm
D2-DNN51B

■ Frame B (D2x-04xx-E(Note)-Bx)



Unit:mm
D2-DNN50B

■ Frame D (D2x-20xx-E(Note)-Dx)



Unit:mm
D2-DNN53A

Note Interface E/F/K/U are plug-in module

6.5 Drive peripheral kits

■ Connector Kit

| Part Name | Model | Description | Quantity |
|---------------------------------|--------|--|----------|
| Frame A-C | D2-CK3 | CN1 Main power, motor power, regenerative resistor and control power connector / 12pins, pitch5mm (051500400249) | 1 |
| | | CN2 Brake connector: 4pins, pitch 3.5mm (051500400285) | 1 |
| | | CN6 Control signal connector: 50 pins welded type(051500100127) | 1 |
| | | CN1 Connector fixture tool (051800400035) | 1 |
| | | CN2 Connector fixture tool (051800400066) | 1 |
| Frame D (with Modbus interface) | D2-CK4 | CN1 Connectors of AC power, drive control power, regenerative resistor, and DC reactor. 11 pins, TE 1-2229794-1-PT1. | 1 |
| | | CN2 Motor power connector. 3 pins, TE 3-22297894-1. | 1 |
| | | CN4 Connector kit for serial communication. TE 2040008-1. | 1 |
| | | CN5 Safety function connector. TE 1971153-1. | 1 |
| | | CN6 Control signal connector. 50 pins, welded type, EUMAX XDR-10350AS. | 1 |
| | | CN1 CN2 Connector fixture tools: TE 1981045-1. | 2 |
| Frame D | D2-CK5 | CN1 Connectors of AC power, drive control power, regenerative resistor, and DC reactor. 11 pins, TE 1-2229794-1-PT1. | 1 |
| | | CN2 Motor power connector. 3 pins,TE 3-22297894-1. | 1 |
| | | CN5 Safety function connector. TE 1971153-1. | 1 |
| | | CN6 Control signal connector. 50 pins welded type, EUMAX XDR-10350AS. | 1 |
| | | CN1 CN2 Connector fixture tools: TE 1981045-1. | 2 |

■ EMC Accessory Kit

| Part Name | Model | Description | Quantity |
|---------------------------------------|------------------------|---|----------|
| D2 EMC accessory kit for single phase | D2-EMC1 (051800200074) | Single phase filter FN2090-6-06 for 50W to 400W (Rated current:6A, leakage current: 0.67mA) | 1 |
| | | EMI core KCF-130-B | 2 |
| | D2-EMC3 (051800200077) | Single phase filter FN2090-10-06 for 750W and 1000W (Rated current:10A, leakage current: 0.67mA) | 1 |
| | | EMI magnet rings KCF-130-B | 2 |
| D2 EMC accessory kit for three phase | D2-EMC2 (051800200075) | Three phase filter FN3025HL-20-71 (Rated current:20A, leakage current:0.4mA) | 1 |
| | | EMI magnet rings KCF-130-B | 2 |
| | D2-EMC4 (051800200078) | Three phase filter B84743C0035R166 (Rated current:35A, leakage current: <0.5mA) | 1 |
| | | EMI magnet rings KCF-130-B | 2 |

EMI magnetic rings are applied on main power cables, motor power cables, encoder wires or pulse control wires respectively.

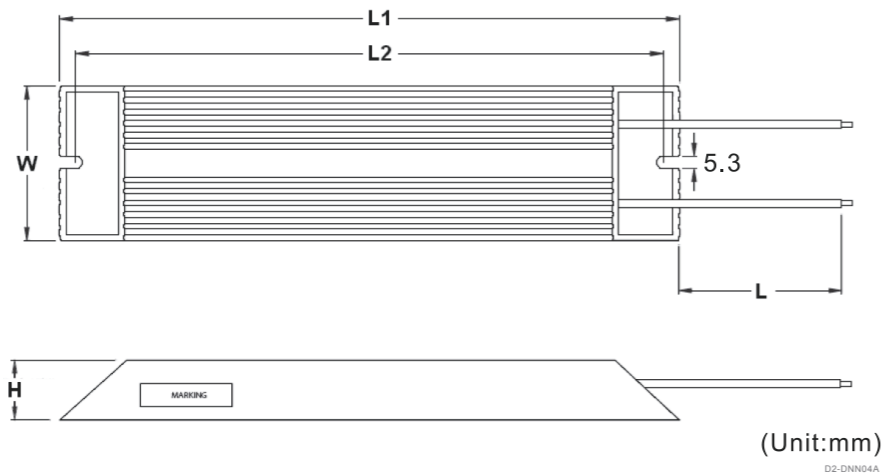
- ! 1. The leakage current of some models' noise filters is large. Therefore the leakage current will increase due to the ground conditions. When applying leak detectors and leakage circuit breakers, please consider on the basis of ground conditions and noise filters issues how to select. Please contact noise filter manufacturers for details.
- 2. The filter can be connected to more than one drive if the total maximum load current does not exceed the rated current.

7. Servo Motor

7.1 Motor specifications and application environment

Regenerative Resistor

| Part Name | Model | Description | L1 | L2 | W | H | L |
|-----------------------|-------|--|---------|---------|----------|----------|-----|
| Regenerative resistor | RG1 | 68Ω Rated power 100W Peak power 500W (050100700001) | 165 ± 2 | 150 ± 2 | 40 ± 0.5 | 40 ± 0.5 | 500 |
| | RG2 | 120Ω Rated power 300W Peak power 1500W (050100700009) | 215 ± 2 | 200 ± 2 | 60 ± 0.5 | 30 ± 0.5 | 500 |


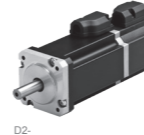
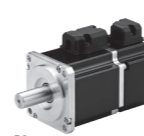









Common Mode Filter

| Part Name | Model | Description | Quantity |
|--------------------|---------------------------|---|----------|
| Common mode filter | MF-CM-S (FF000MF11002) | Common mode inductance: 1100 μ H (nominal) for 50W to 2000W (Voltage maximum: 373Vdc, Rated current: 11Arms) | 1 |

DC Reactor

| Part Name | Model | Description | Quantity |
|------------|---------------------------------|--|----------|
| DC Reactor | B86732G15L712 (051800200126) | 1-phase DC reactor for 2000W Rated Voltage : 440Vdc Rated current : 14.2A Inductance: 2.45mH(nominal) | 1 |

| Motor | Rated output (W) | Voltage | Rated speed (No-load maximum speed) (rpm) | Encoder | IP level | Application | Environment | |
|---------------------|--|---------|---|-------------|----------|---|---|------|
| Low Inertia FRLS |  D2-PPN02A | 220V | 3000 (4500) | 13bit/17bit | IP65 | Semiconductor Equipment Packaging Machine SMT Machine Food industry machine LCD equipment | <ul style="list-style-type: none"> Storage condition <ul style="list-style-type: none"> - Indoor illumination - Keep away from following environment <ul style="list-style-type: none"> a. corrosive gases b. flammable gas c. grease and dirt Application temperature 0 ° C ~ 40 ° C Storage Temperature -15 ° C ~ 70 ° C Humidity 80% RH or less Storage humidity 80% RH or less Elevation above sea level 1000m under Vibration resistance 49m/s² or less | |
| |  D2-PPN03A | | | | | | | 50W |
| |  D2-PPN04A | | | | | | | 100W |
| |  D2-PPN05A | | | | | | | 200W |
| | 400W | | | | | | | |

| Motor | Rated output (W) | Voltage | Rated speed (No-load maximum speed) (rpm) | Encoder | IP level | Application | Environment | |
|-------|--|---------|---|-------------|----------|---|---|-------|
| FRMS |  | 220V | 3000 (4500) | 17bit | IP65 | Semiconductor Equipment Packaging Machine SMT Machine Food industry machine LCD equipment | <ul style="list-style-type: none"> Storage condition <ul style="list-style-type: none"> - Indoor illumination - Keep away from following environment <ul style="list-style-type: none"> a. corrosive gases b. flammable gas c. grease and dirt Application temperature <ul style="list-style-type: none"> 0 °C ~ 40 °C Storage Temperature <ul style="list-style-type: none"> -15 °C ~ 70 °C Humidity <ul style="list-style-type: none"> 80% RH or less Storage humidity <ul style="list-style-type: none"> 80% RH or less Elevation above sea level <ul style="list-style-type: none"> 1000m under Vibration resistance <ul style="list-style-type: none"> 49m/s² or less | |
| |  | | | | | | | 50W |
| |  | | | | | | | 100W |
| |  D2-PPN06A | | | | | | | 400W |
| FRMM |  D2-PPN07A | 220V | 2000 (3000) | 13bit/17bit | IP65 | Machine Tools Conveyor Equipment Textile Machine Mechanical arm | <ul style="list-style-type: none"> Vibration resistance <ul style="list-style-type: none"> 49m/s² or less | |
| |  D2-PPN11A | | | | | | | 750W |
| | | | | 2000W | | | | 17bit |

7.2 Low inertia, Small capacity

7.2.1 50W

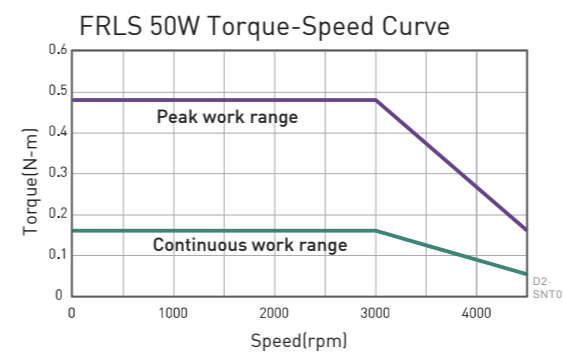
| Parameter | Symbol | Unit | FRLS052□□A4□ |
|--|--|--|--------------|
| Drive Input Voltage | V | V | AC220 |
| Rated Power | W | W | 50 |
| Rated Torque | Tc | N.m | 0.16 |
| Rated Current | Ic | A(rms) | 0.9 |
| Peak Max. Torque | Tp | N.m | 0.48 |
| Peak Max. Current | Ip | A(rms) | 2.7 |
| Rated Speed | ω_c | rpm | 3000 |
| Max. Speed | ω_p | rpm | 4500 |
| Torque Constant | Kt | N.m / Arms | 0.178 |
| Back EMF Constant | Ke | Vrms / krpm | 10.74 |
| Resistance (line to line) | R | Ω | 4.7 |
| Inductance (line to line) | L | mH | 4.7 |
| Inertia of Rotating Parts (with brake) | J | kg-m ² ($\times 10^{-4}$) | 0.02(0.022) |
| Weight (with brake) | M | kg | 0.45(0.58) |
| Motor Insulation Grade | Class A (UL) | | |
| Motor protect | Total enclosed, self-cooled, IP65 (Except for shaft and connector) | | |
| Insulation resistance | 10M Ω , DC500V | | |
| Insulation voltage resistance | AC1500V, 60 second | | |

Brake specifications (Note 1)

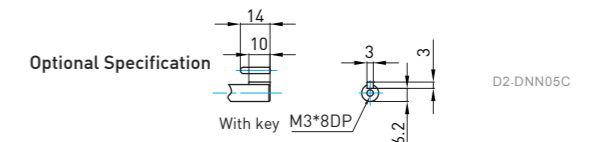
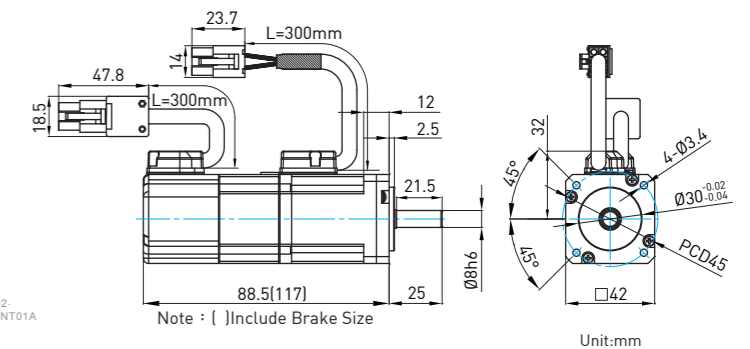
| | | | |
|----------------------------------|----|-----|----------------|
| Static friction torque (Minimum) | Tb | N.m | 0.3 |
| Magnetizing current | Ab | A | 0.25A |
| Brake input voltage | V | V | DC24 \pm 10% |
| Suction time (Maximum) | to | ms | 30 |
| Release time (Maximum) | tr | ms | 20 |

Note 1 Brakes are for maintaining object stop. Do not apply for deceleration, dynamic braking or emergency stop. Brake suction and release times vary with different circuitries, please note the actual operation delay time during application.

Torque-Speed Curve



Dimensions



7.2.2 100W

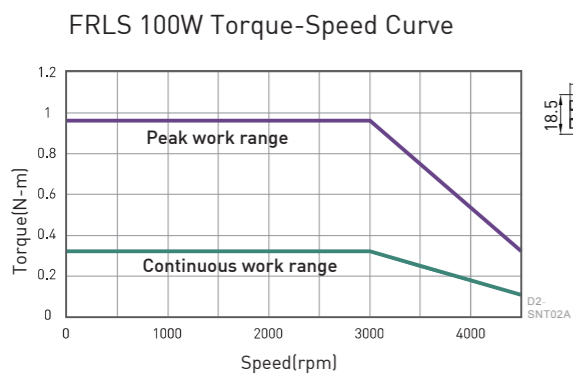
| Parameter | Symbol | Unit | FRLS102□□A4□ |
|--|---|--|--------------|
| Drive Input Voltage | V | V | AC220 |
| Rated Power | W | W | 100 |
| Rated Torque | Tc | N.m | 0.32 |
| Rated Current | Ic | A(rms) | 0.9 |
| Peak Max. Torque | Tp | N.m | 0.96 |
| Peak Max. Current | Ip | A(rms) | 2.7 |
| Rated Speed | ω_c | rpm | 3000 |
| Max. Speed | ω_p | rpm | 4500 |
| Torque Constant | Kt | N.m / Arms | 0.356 |
| Back EMF Constant | Ke | Vrms / krpm | 21.98 |
| Resistance (line to line) | R | Ω | 8 |
| Inductance (line to line) | L | mH | 8.45 |
| Inertia of Rotating Parts (with brake) | J | kg·m ² ($\times 10^{-4}$) | 0.036(0.038) |
| Weight (with brake) | M | kg | 0.63(0.76) |
| Motor Insulation Grade | Class A (UL) | | |
| Motor protect | Total enclosed, self-cooled, IP65 (Except for shaft and connector) | | |
| Insulation resistance | 10M Ω , DC500V | | |
| Insulation voltage resistance | AC1500V, 60 second | | |

Brake specifications (Note 1)

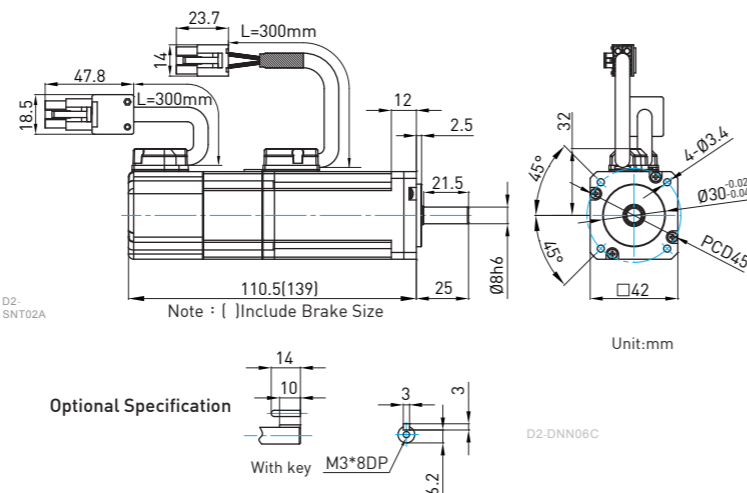
| | | | |
|----------------------------------|----|-----|----------------|
| Static friction torque (Minimum) | Tb | N.m | 0.3 |
| Magnetizing current | Ab | A | 0.25A |
| Brake input voltage | V | V | DC24 \pm 10% |
| Suction time (Maximum) | to | ms | 30 |
| Release time (Maximum) | tr | ms | 20 |

Note 1 Brakes are for maintaining object stop. Do not apply for deceleration, dynamic brakeing or emergency stop. Brake suction and release times vary with different circuitries, please note the actual operation delay time during application.

Torque-Speed Curve



Dimensions



7.2.3 200W

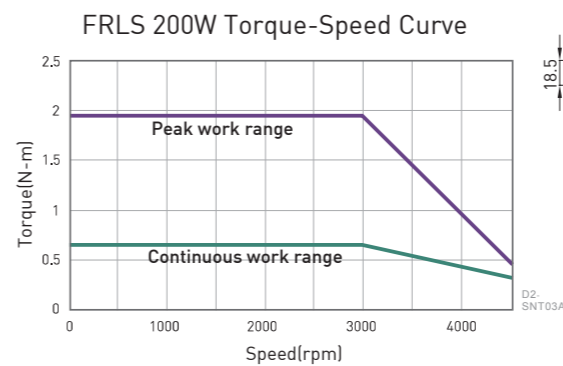
| Parameter | Symbol | Unit | FRLS202□□06□ |
|--|---|--|--------------|
| Drive Input Voltage | V | V | AC220 |
| Rated Power | W | W | 200 |
| Rated Torque | Tc | N.m | 0.64 |
| Rated Current | Ic | A(rms) | 1.7 |
| Peak Max. Torque | Tp | N.m | 1.92 |
| Peak Max. Current | Ip | A(rms) | 5.1 |
| Rated Speed | ω_c | rpm | 3000 |
| Max. Speed | ω_p | rpm | 4500 |
| Torque Constant | Kt | N.m / Arms | 0.38 |
| Back EMF Constant | Ke | Vrms / krpm | 23 |
| Resistance (line to line) | R | Ω | 4.3 |
| Inductance (line to line) | L | mH | 13 |
| Inertia of Rotating Parts (with brake) | J | kg·m ² ($\times 10^{-4}$) | 0.17(0.21) |
| Weight (with brake) | M | kg | 0.95(1.5) |
| Motor Insulation Grade | Class A (UL) | | |
| Motor protect | Total enclosed, self-cooled, IP65 (Except for shaft and connector) | | |
| Insulation resistance | 10M Ω , DC500V | | |
| Insulation voltage resistance | AC1500V, 60 second | | |

Brake specifications (Note 1)

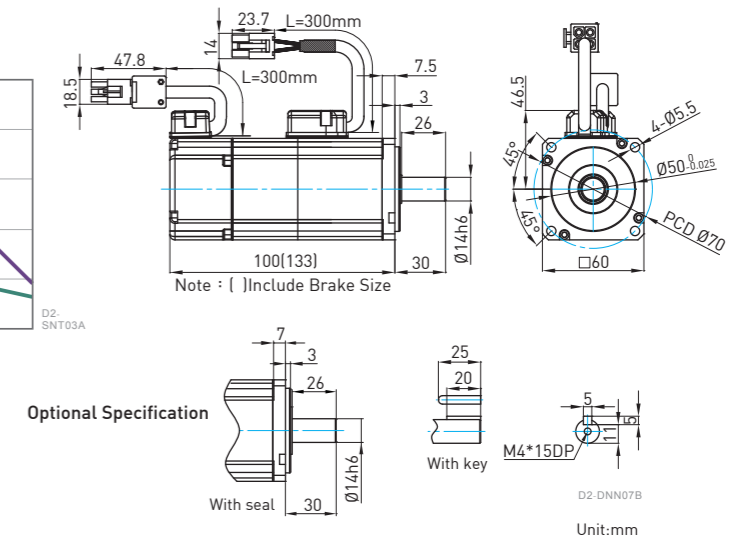
| | | | |
|----------------------------------|----|-----|----------------|
| Static friction torque (Minimum) | Tb | N.m | 1.3 |
| Magnetizing current | Ab | A | 0.32A |
| Brake input voltage | V | V | DC24 \pm 10% |
| Suction time (Maximum) | to | ms | 30 |
| Release time (Maximum) | tr | ms | 20 |

Note 1 Brakes are for maintaining object stop. Do not apply for deceleration, dynamic brakeing or emergency stop. Brake suction and release times vary with different circuitries, please note the actual operation delay time during application.

Torque-Speed Curve



Dimensions



7.3.2 100W

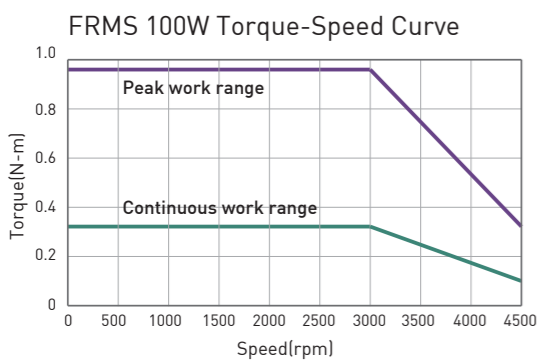
| Parameter | Symbol | Unit | FRMS102□□04□ |
|--|--|--|--------------|
| Drive Input Voltage | V | V | AC220 |
| Rated Power | W | W | 100 |
| Rated Torque | Tc | N.m | 0.32 |
| Rated Current | Ic | A(rms) | 0.9 |
| Peak Max. Torque | Tp | N.m | 0.96 |
| Peak Max. Current | Ip | A(rms) | 2.7 |
| Rated Speed | ω_c | rpm | 3000 |
| Max. Speed | ω_p | rpm | 4500 |
| Torque Constant | Kt | N.m / Arms | 0.356 |
| Back EMF Constant | Ke | Vrms / krpm | 20.93 |
| Resistance (line to line) | R | Ω | 19 |
| Inductance (line to line) | L | mH | 23.78 |
| Inertia of Rotating Parts (with brake) | J | kg-m ² ($\times 10^{-4}$) | 0.051(0.055) |
| Weight (with brake) | M | kg | 0.54(0.67) |
| Motor Insulation Grade | Class A (UL) | | |
| Motor protect | Total enclosed, self-cooled, IP65 (Except for shaft and connector) | | |
| Insulation resistance | 10M Ω , DC500V | | |
| Insulation voltage resistance | AC1500V, 60 second | | |

Brake specifications (Note 1)

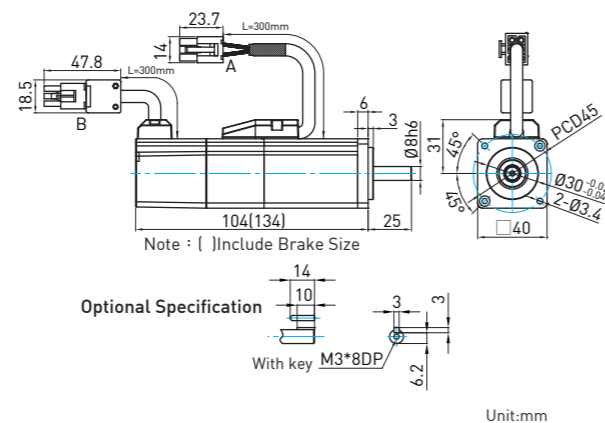
| | | | |
|----------------------------------|----|-----|----------------|
| Static friction torque (Minimum) | Tb | N.m | 0.32 |
| Magnetizing current | Ab | A | 0.25A |
| Brake input voltage | V | V | DC24 \pm 10% |
| Suction time (Maximum) | to | ms | 40 |
| Release time (Maximum) | tr | ms | 20 |

Note 1 Brakes are for maintaining object stop. Do not apply for deceleration, dynamic braking or emergency stop. Brake suction and release times vary with different circuitries, please note the actual operation delay time during application.

■ Torque-Speed Curve



■ Dimensions



7.3.3 400W

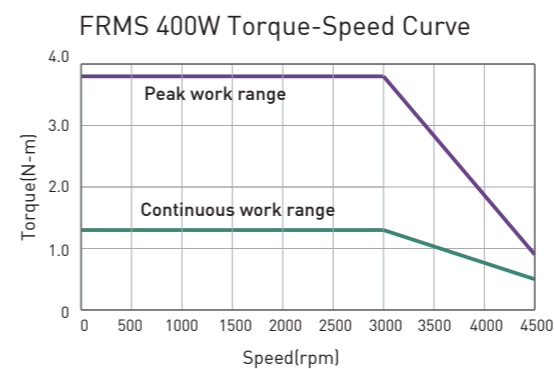
| Parameter | Symbol | Unit | FRMS4B2□□06□ |
|--|--|--|--------------|
| Drive Input Voltage | V | V | AC220 |
| Rated Power | W | W | 400 |
| Rated Torque | Tc | N.m | 1.27 |
| Rated Current | Ic | A(rms) | 2.6 |
| Peak Max. Torque | Tp | N.m | 3.81 |
| Peak Max. Current | Ip | A(rms) | 7.8 |
| Rated Speed | ω_c | rpm | 3000 |
| Max. Speed | ω_p | rpm | 4500 |
| Torque Constant | Kt | N.m / Arms | 0.48 |
| Back EMF Constant | Ke | Vrms / krpm | 29.61 |
| Resistance (line to line) | R | Ω | 4.13 |
| Inductance (line to line) | L | mH | 9.9 |
| Inertia of Rotating Parts (with brake) | J | kg-m ² ($\times 10^{-4}$) | 0.44(0.48) |
| Weight (with brake) | M | kg | 1.31(1.86) |
| Motor Insulation Grade | Class A (UL) | | |
| Motor protect | Total enclosed, self-cooled, IP65 (Except for shaft and connector) | | |
| Insulation resistance | 10M Ω , DC500V | | |
| Insulation voltage resistance | AC1500V, 60 second | | |

Brake specifications (Note 1)

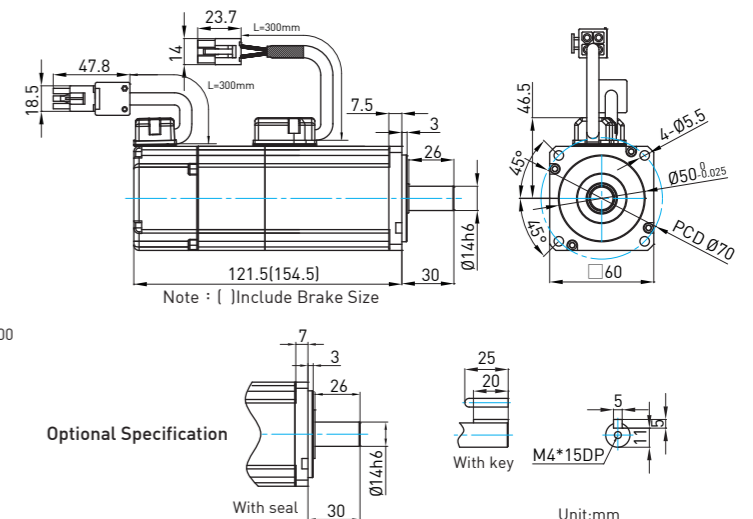
| | | | |
|----------------------------------|----|-----|----------------|
| Static friction torque (Minimum) | Tb | N.m | 1.3 |
| Magnetizing current | Ab | A | 0.32 |
| Brake input voltage | V | V | DC24 \pm 10% |
| Suction time (Maximum) | to | ms | 30 |
| Release time (Maximum) | tr | ms | 20 |

Note 1 Brakes are for maintaining object stop. Do not apply for deceleration, dynamic braking or emergency stop. Brake suction and release times vary with different circuitries, please note the actual operation delay time during application.

■ Torque-Speed Curve



■ Dimensions



7.3.4 750W

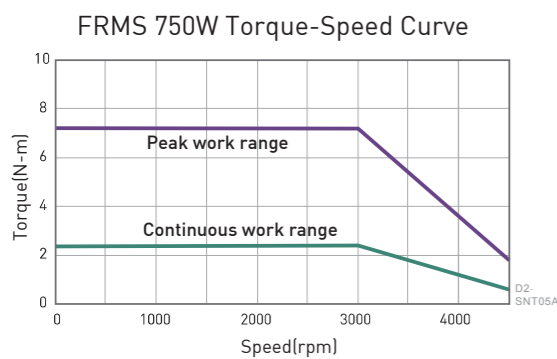
| Parameter | Symbol | Unit | FRMS752□□08□ |
|--|--|--|--------------|
| Drive Input Voltage | V | V | AC220 |
| Rated Power | W | W | 750 |
| Rated Torque | Tc | N.m | 2.4 |
| Rated Current | Ic | A(rms) | 5.1 |
| Peak Max. Torque | Tp | N.m | 7.2 |
| Peak Max. Current | Ip | A(rms) | 15.3 |
| Rated Speed | ω_c | rpm | 3000 |
| Max. Speed | ω_p | rpm | 4500 |
| Torque Constant | Kt | N.m / Arms | 0.47 |
| Back EMF Constant | Ke | Vrms / krpm | 28.4 |
| Resistance (line to line) | R | Ω | 0.813 |
| Inductance (line to line) | L | mH | 3.4 |
| Inertia of Rotating Parts (with brake) | J | kg-m ² ($\times 10^{-4}$) | 1.4(1.46) |
| Weight (with brake) | M | kg | 2.66(3.32) |
| Motor Insulation Grade | Class A (UL) | | |
| Motor protect | Total enclosed, self-cooled, IP65 (Except for shaft and connector) | | |
| Insulation resistance | 10M Ω , DC500V | | |
| Insulation voltage resistance | AC1500V, 60 second | | |

Brake specifications (Note 1)

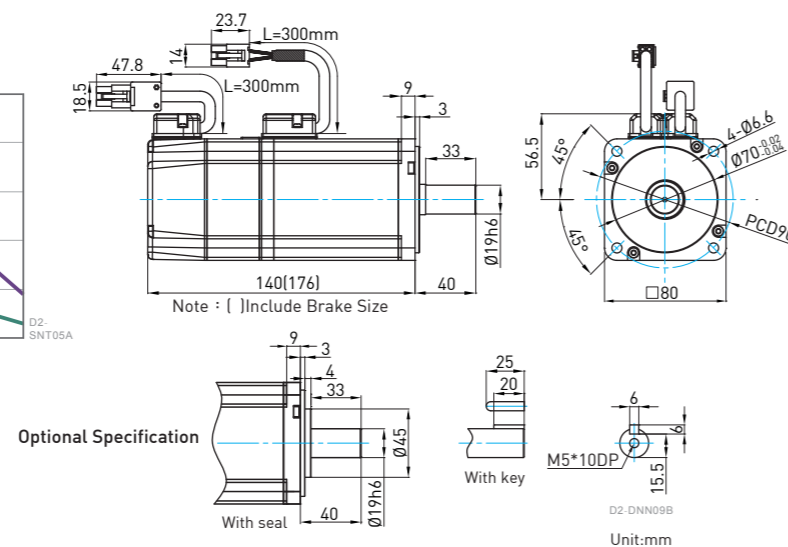
| | | | |
|----------------------------------|----|-----|-----------------|
| Static friction torque (Minimum) | Tb | N.m | 2.4 |
| Magnetizing current | Ab | A | 0.358A |
| Brake input voltage | V | V | DC24 $\pm 10\%$ |
| Suction time (Maximum) | to | ms | 45 |
| Release time (Maximum) | tr | ms | 10 |

Note 1 Brakes are for maintaining object stop. Do not apply for deceleration, dynamic braking or emergency stop. Brake suction and release times vary with different circuitries, please note the actual operation delay time during application.

Torque-Speed Curve



Dimensions



7.4 Middle inertia, Middle capacity

7.4.1 1000W

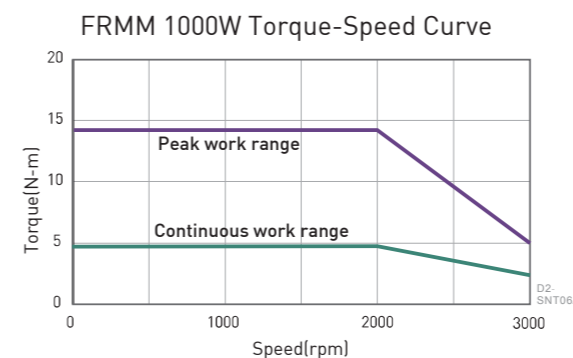
| Parameter | Symbol | Unit | FRMM1K2□□13□ |
|--|--|--|--------------|
| Drive Input Voltage | V | V | AC220 |
| Rated Power | W | W | 1000 |
| Rated Torque | Tc | N.m | 4.77 |
| Rated Current | Ic | A(rms) | 5.1 |
| Peak Max. Torque | Tp | N.m | 14.3 |
| Peak Max. Current | Ip | A(rms) | 15.3 |
| Rated Speed | ω_c | rpm | 2000 |
| Max. Speed | ω_p | rpm | 3000 |
| Torque Constant | Kt | N.m / Arms | 0.94 |
| Back EMF Constant | Ke | Vrms / krpm | 54.7 |
| Resistance (line to line) | R | Ω | 0.81 |
| Inductance (line to line) | L | mH | 8 |
| Inertia of Rotating Parts (with brake) | J | kg-m ² ($\times 10^{-4}$) | 7.6(8.7) |
| Weight (with brake) | M | kg | 5.4(6.2) |
| Motor Insulation Grade | Class A (UL) | | |
| Motor protect | Total enclosed, self-cooled, IP65 (Except for shaft and connector) | | |
| Insulation resistance | 10M Ω , DC500V | | |
| Insulation voltage resistance | AC1500V, 60 second | | |

Brake specifications (Note 1)

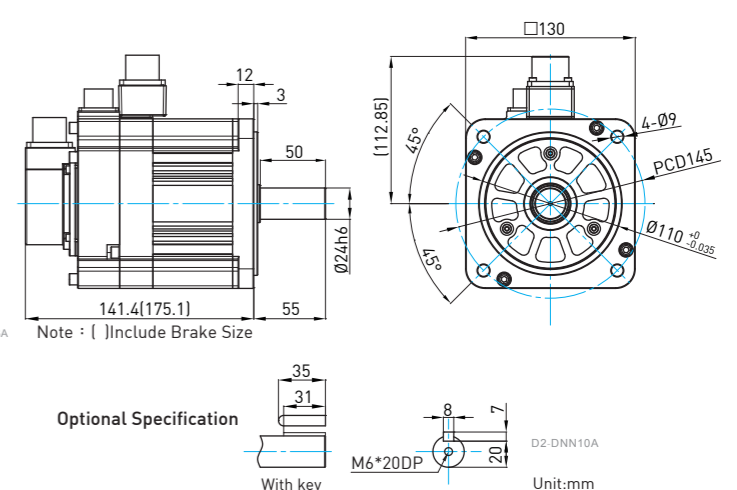
| | | | |
|----------------------------------|----|-----|-------|
| Static friction torque (Minimum) | Tb | N.m | 10 |
| Magnetizing current | Ab | A | 0.56A |
| Brake input voltage | V | V | DC24 |
| Suction time (Maximum) | to | ms | 80 |
| Release time (Maximum) | tr | ms | 30 |

Note 1 Brakes are for maintaining object stop. Do not apply for deceleration, dynamic braking or emergency stop. Brake suction and release times vary with different circuitries, please note the actual operation delay time during application.

Torque-Speed Curve



Dimensions



7.4.2 2000W

| Parameter | Symbol | Unit | FRMM2K2□□13□ |
|--|--|--|--------------|
| Drive Input Voltage | V | V | AC220 |
| Rated Power | W | W | 2000 |
| Rated Torque | Tc | N.m | 9.55 |
| Rated Current | Ic | A(rms) | 11 |
| Peak Max. Torque | Tp | N.m | 28.65 |
| Peak Max. Current | Ip | A(rms) | 33 |
| Rated Speed | ω_c | rpm | 2000 |
| Max. Speed | ω_p | rpm | 3000 |
| Torque Constant | Kt | N.m / Arms | 0.87 |
| Back EMF Constant | Ke | Vrms / krpm | 57.8 |
| Resistance (line to line) | R | Ω | 0.41 |
| Inductance (line to line) | L | mH | 3.7 |
| Inertia of Rotating Parts (with brake) | J | kg·m ² ($\times 10^{-4}$) | 13(14.1) |
| Weight (with brake) | M | kg | 8(8.8) |
| Motor Insulation Grade | Class A (under certification) | | |
| Motor protect | Total enclosed, self-cooled, IP65 (Except for shaft and connector) | | |
| Insulation resistance | 10M Ω , DC500V | | |
| Insulation voltage resistance | AC1500V, 60 second | | |

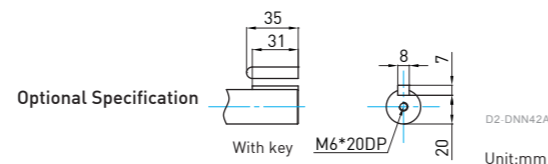
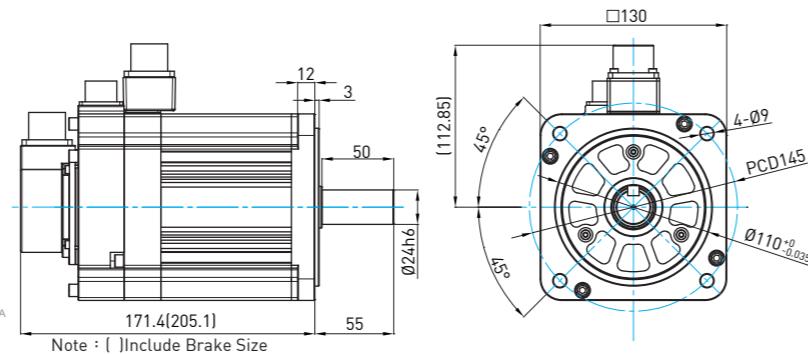
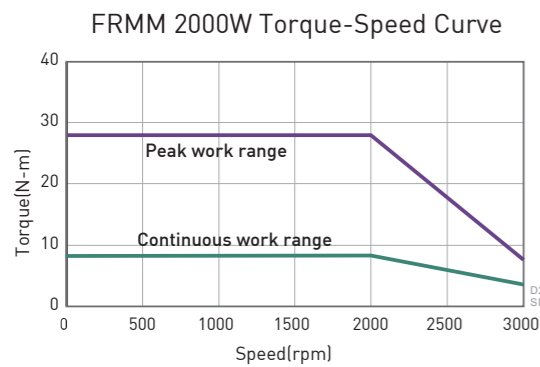
Brake specifications (Note 1)

| | | | |
|----------------------------------|----|-----|-------|
| Static friction torque (Minimum) | Tb | N.m | 10 |
| Magnetizing current | Ab | A | 0.56A |
| Brake input voltage | V | V | DC24 |
| Suction time | to | ms | 80 |
| Release time | tr | ms | 30 |

Note 1 Brakes are for maintaining object stop. Do not apply for deceleration, dynamic braking or emergency stop. Brake suction and release times vary with different circuitries, please note the actual operation delay time during application.

Torque-Speed Curve

Dimensions



8. Cable and connector

8.1 Cable

Small Capacity

| Name | Type | Connect | Description : 50W~750W |
|--|--------------|------------|--|
| AC Servo Motor Power Cable | HVPS04AA□□□B | CN1 | AMP-172159-1 |
| AC Servo Motor Power and Brake Extension Cable | HVPS06AA□□□B | CN1 CN2 | AMP-172160-1 |
| AC Servo Motor Encoder Cable (13bit incremental) | HVE13IAB□□□B | CN7 | AMP-172161-1 3M 36310 3M 36210 |
| AC Servo Motor Encoder Cable (17bit incremental) | HVE17IAB□□□B | | AMP-172161-9 3M 36310 3M 36210 |
| AC Servo Motor Encoder Cable (17bit absolute) | HVE17AAB□□□B | | AMP-1-172161-9 3M 36310 3M 36210 |

■ Middle Capacity – 1000W

| Name | Type | Connect | Description : 1000W |
|--|------------------------------------|---------|---------------------|
| AC Servo Motor Power Cable | HVPM04BA□□□B Straight Connector | CN1 | |
| | HVPM04CA□□□B L-Type Connector | | |
| AC Servo Motor Power Cable and Brake Cable (Note1) | HVPM06BA□□□B Straight Connector | CN1 | |
| | HVPM06CA□□□B L-Type Connector | | |
| | HVPM02BA□□□□ | | |
| | HVPM02CA□□□□ | | |
| AC Servo Motor Encoder Cable (13bit Incremental) | HVE13IBB□□□B Straight Connector | | |
| | HVE13ICB□□□B L-Type Connector | | |
| AC Servo Motor Encoder Cable (17bit incremental) | HVE17IBB□□□B Straight Connector | CN7 | |
| | HVE17ICB□□□B L-Type Connector | | |
| AC Servo Motor Encoder Cable (17bit absolute) | HVE17ABB□□□B Straight Connector | | |
| | HVE17ACB□□□B L-Type Connector | | |

Note1 For middle capacity motors with brake, please remember to use power cable and brake cable simultaneously.

■ Middle Capacity – 2000W

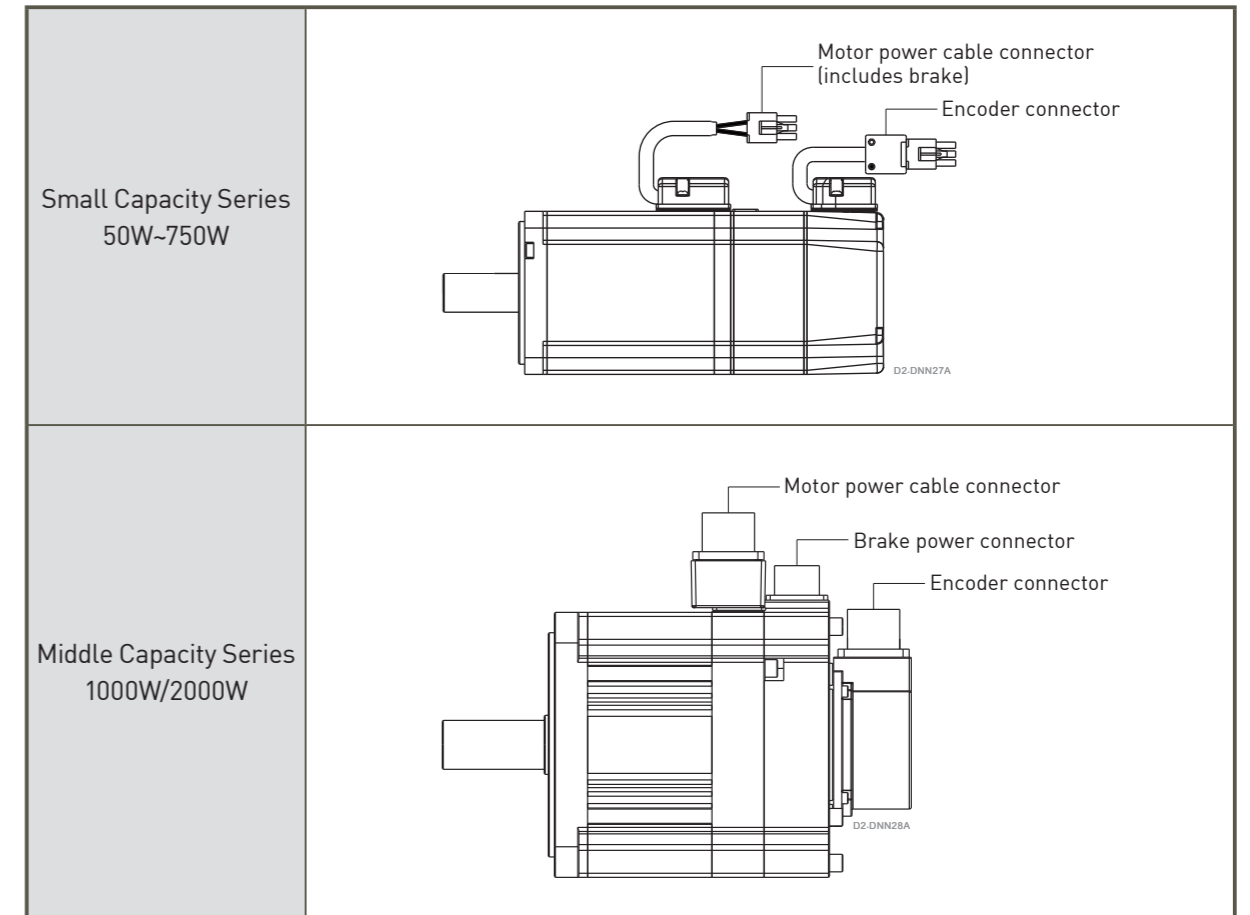
| Name | Type | Connect | Description : 2000W |
|--|------------------------------------|---------|---------------------|
| AC Servo Motor Power Cable | HVPM04BB□□□B Straight Connector | CN1 | |
| | HVPM04CB□□□B L-Type Connector | | |
| AC Servo Motor Power Cable and Brake Cable (Note1) | HVPM06BB□□□B Straight Connector | CN1 | |
| | HVPM06CB□□□B L-Type Connector | | |
| | HVPM02BB□□□□ | | |
| | HVPM02CB□□□□ | | |
| AC Servo Motor Encoder Cable (17bit incremental) | HVE17IBB□□□B Straight Connector | | |
| | HVE17ICB□□□B L-Type Connector | | |
| AC Servo Motor Encoder Cable (17bit absolute) | HVE17ABB□□□B Straight Connector | CN7 | |
| | HVE17ACB□□□B L-Type Connector | | |
| | HE00817DR300(3m) | | |

Note1 For middle capacity motors with brake, please remember to use power cable and brake cable simultaneously.

■ Communication and Interface Cable

| Name | Type | Connect | |
|--------------------|--------------------|-----------|---|
| Mini USB Cable | 051700800366 | CN3 | USB A type (2m) Mini USB D2-DNN25A |
| | HE00834S0800(0.3m) | CN4 / CN5 | D2 Modbus Communication Cable(only for fram A,B,C) Specification : HE00834S0800(0.3m) · HE00834S0900(1m) · HE00834S1000(2m) · HE00834S1100(3m) |
| | HE00834S0900(1m) | | |
| | HE00834S1000(2m) | | |
| HE00834S1100(3m) | | | |
| Interface Cable | HE00815AC200 | CN6 | D2-DNN26A |
| IO Extension Cable | HE00834S1200(3m) | CN6 | D2 Drive Extension IO Cable Specification : HE00834S1200(3m) |

8.2 Connector

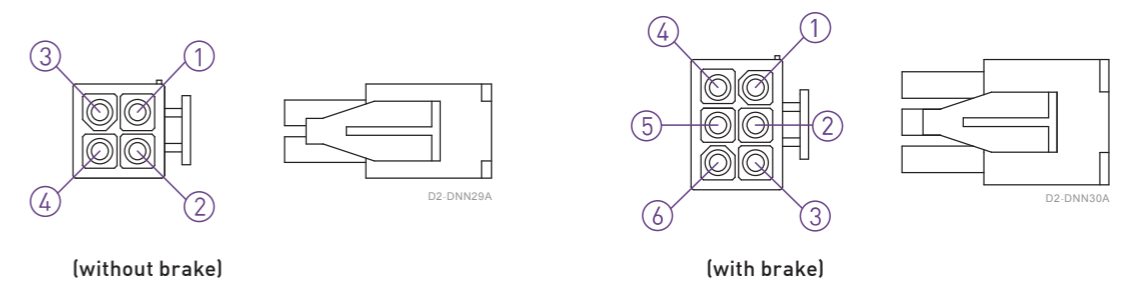


■ Motor Power Connector

Small Capacity Series / 50W~750W

| Signal | AMP-172167-1 (without brake) | AMP-172168-1 (with brake) |
|--------|---------------------------------|------------------------------|
| U | 3 | 3 |
| V | 2 | 2 |
| W | 1 | 1 |
| GND | 4 | 4 |
| B+ | -- | 5 |
| B- | -- | 6 |

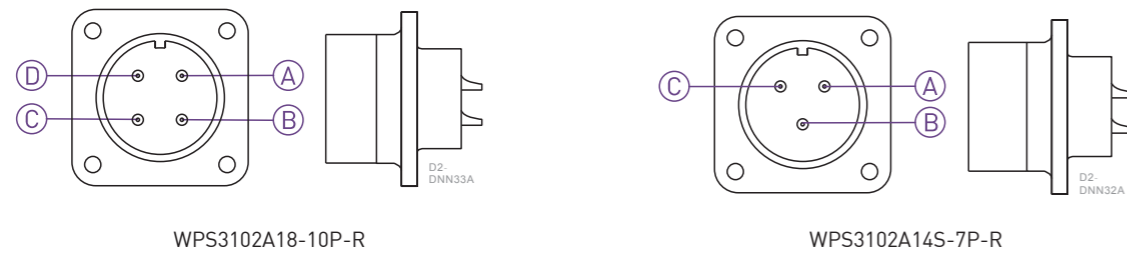
Connect Pins Position Definition



Middle Capacity Series /1000W · 2000W

| Signal | WPS3102A18-10P-R | WPS3102A14S-7P-R |
|--------|------------------|------------------|
| U | A | -- |
| V | B | -- |
| W | C | -- |
| GND | D | -- |
| B+ | -- | A |
| B- | -- | C |

Connect Pins Position Definition

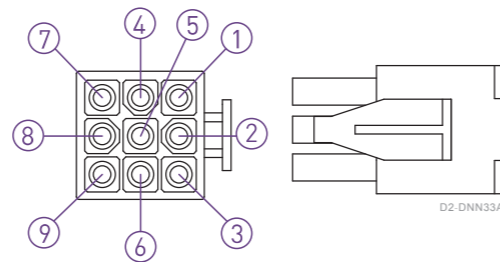


! By brake Type, two connectors must be used simultaneously

■ Encoder Connector

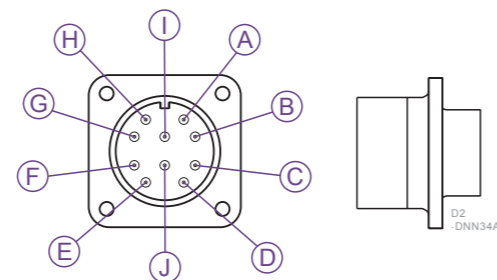
13bit Incremental / 50W~750W

| Function | Signal | AMP-172169-1 |
|------------------------------------|-----------|--------------|
| Power | 5V±5% | 1 |
| | 0V | 2 |
| Incremental Signal/ Hall signal | A+ U+ | 3 |
| | A- U- | 4 |
| | B+ V+ | 5 |
| | B- V- | 6 |
| | Z+ W+ | 7 |
| | Z- W- | 8 |
| Shielding | Shielding | 9 |



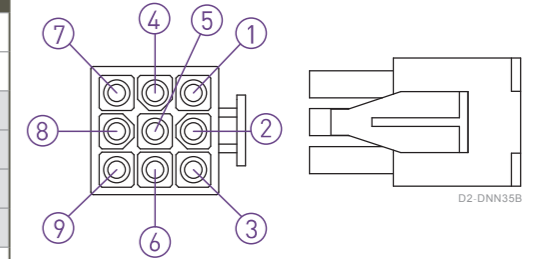
13bit Incremental / 1000W

| Function | Signal | WPS3102A18-1P-R |
|------------------------------------|-----------|-----------------|
| Power | 5V±5% | A |
| | 0V | B |
| Incremental Signal/ Hall signal | A+ U+ | C |
| | A- U- | D |
| | B+ V+ | E |
| | B- V- | F |
| | Z+ W+ | G |
| | Z- W- | H |
| Shielding | Shielding | I |



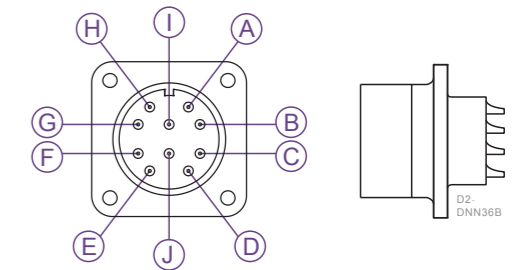
17bit incremental / 50W~750W

| Function | Signal | AMP1-172169-9 |
|--------------------|-----------|---------------|
| Power | 5V±5% | 1 |
| | 0V | 2 |
| Serial Data Signal | SL+ | 3 |
| | SL- | 4 |
| | MA+ | 7 |
| | MA- | 8 |
| Shielding | Shielding | 9 |



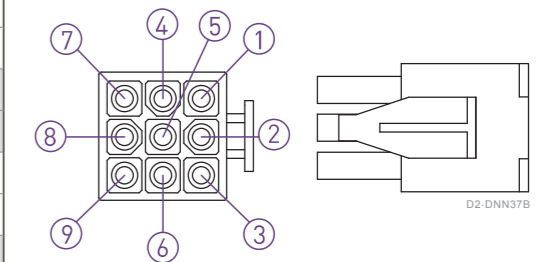
17bit incremental / 1000W · 2000W

| Function | Signal | WPS3102A18-1P-R |
|--------------------|-----------|-----------------|
| Power | 5V±5% | A |
| | 0V | B |
| Serial Data Signal | SL+ | C |
| | SL- | D |
| | MA+ | G |
| | MA- | H |
| Shielding | Shielding | I |



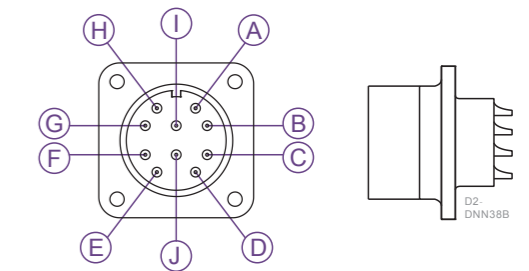
17bit absolute / 50W~750W

| Function | Signal | AMP-1-172169-9 |
|--------------------|-----------|----------------|
| Power | 5V | 1 |
| | 0V | 2 |
| Battery | VB | 5 |
| | GND | 6 |
| Serial Data Signal | SD+ | 7 |
| | SD- | 8 |
| Shielding | Shielding | 9 |



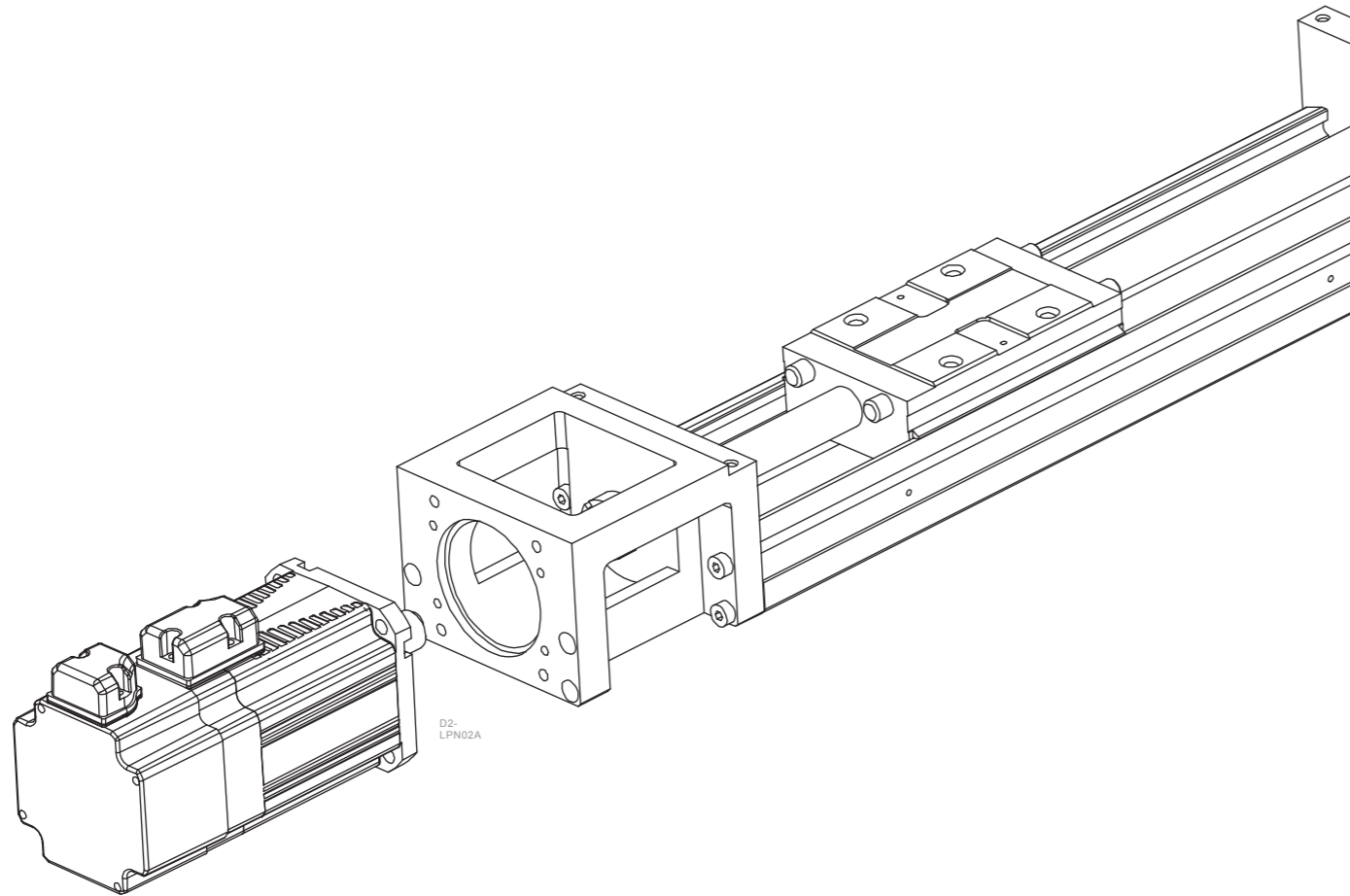
17bit absolute / 1000W · 2000W

| Function | Signal | WPS3102A18-1P-R |
|--------------------|-----------|-----------------|
| Power | 5V | A |
| | 0V | B |
| Battery | VB | E |
| | GND | F |
| Serial Data Signal | SD+ | G |
| | SD- | H |
| Shielding | Shielding | I |



9. HIWIN single axis robot and motor adaptor flange

| AC Servo Motor | | HIWIN single axis robot | | | | | | | Drive |
|----------------|--------------|-------------------------|------|------|------|------|-------|-------|---------------|
| | | KK40 | KK50 | KK60 | KK80 | KK86 | KK100 | KK130 | |
| 50W | FRLS052XXA4X | F2 | F2 | F2 | F3 | F3 | F1 | - | D2x-01xx-x-Ax |
| 100W | FRLS102XXA4X | F2 | F2 | F2 | F3 | F3 | - | - | D2x-01xx-x-Ax |
| 200W | FRLS202XX06X | - | - | - | F0 | F0 | F0 | F1 | D2x-04xx-x-Bx |
| 400W | FRLS402XX06X | - | - | - | F0 | F0 | F0 | F1 | D2x-04xx-x-Bx |
| 750W | FRMS752XX08X | - | - | - | - | - | F1 | F2 | D2x-10xx-x-Cx |



10. Servo Motor Selection Guide

The motor selection guide in this chapter is located on-line at <http://www.hiwinmikro.tw/hiwincal.aspx>

1. Definition of mechanism to be driven by the motor.

Define detailed dimensions of individual mechanical components (ex: ball screw length, lead and pulley diameter)

Typical servo mechanisms are listed as follows:

[Ball screw mechanism]

[Belt mechanism]

[Rack and pinion mechanism]

[Reduction gear mechanism]

2. Definition of operating pattern (motion velocity profile).

The operating pattern can be defined by the following parameters: acceleration/deceleration time, constant-velocity time, stop time, cycle time, travel distance.

3. Calculation of load inertia and motor inertia ratio.

Calculate load inertia for each mechanical component. (Refer to "General inertia calculation method" described later.)

Then, divide the calculated load inertia by the inertia of the selected motor then check the inertia ratio. Note that the ratio should less than 10, if the selected motor is less than 750W. If the power of selected motor is higher than 1000W, the ratio should less than 10.

4. Calculation of motor velocity.

Calculate the motor velocity from the moving distance, acceleration/deceleration time and constant-velocity time.

5. Calculation of torque.

Calculate the required motor torque from the load inertia, acceleration/deceleration time and constant-velocity time.

6. Calculation of motor

Select a motor that meets the above 3 to 5 requirements.

10.1 Introduction of motor selection relevant parameters

■ Peak torque

Peak torque indicates the maximum torque that the motor requires during operation (mainly in acceleration and deceleration steps). The reference value is 80% or less of the maximum motor torque. If the torque is a negative value, a regenerative discharge resistor may be required.

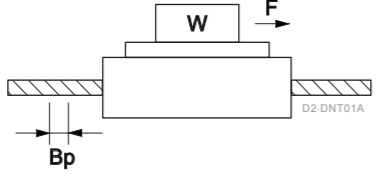
■ Traveling torque, stop holding torque

Traveling torque indicates the torque that the motor requires for a long time. Stop holding torque indicates that the amount of torque required for a motor to remain in a fixed position.

Traveling torque calculation formula for each mechanism.

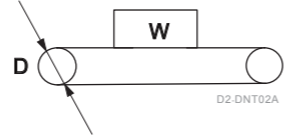
List of symbol :

- W : Workpiece weight [kg]
- B_p : Lead [m]
- D : Pulley diameter [m]
- F : External force [N]
- B_{eff} : Mechanical efficiency
- μ : Coefficient of friction
- g : Acceleration of gravity 9.8[m/s²]



Traveling torque

$$T_f = \frac{B_p}{2\pi B_{eff}} (\mu g W + F)$$



Traveling torque

$$T_f = \frac{D}{2\pi B_{eff}} (\mu g W + F)$$

■ Effective torque

Effective torque indicates a root-mean-square value of the total required for running and stopping the motor per unit time. The reference value is approximate 80% or less of the rated motor torque.

$$T_{rms} = \sqrt{\frac{T_a^2 \times t_a + T_f^2 \times t_b + T_d^2 \times t_d}{t_c}}$$

T_a: Acceleration torque [N-m]

T_f: Traveling torque [N-m]

T_d: Deceleration torque [N-m]

t_c: Cycle time [s] (Run time + Stop time)

t_a: Acceleration time [s]

t_b: constant-velocity time [s]

t_d: Deceleration time [s]

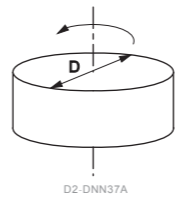
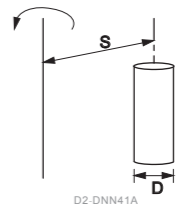
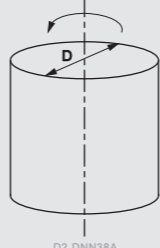
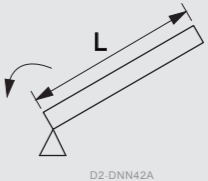
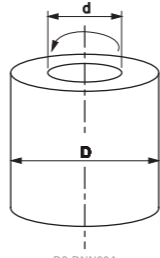
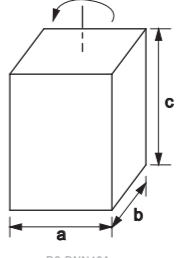
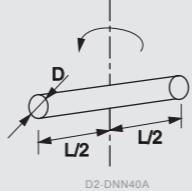
■ Motor velocity

Maximum velocity of motor in operation: The reference value is the rated velocity or lower value. When the motor operates at the maximum velocity, you must pay attention to the motor torque and temperature rise.

■ Load inertia and motor inertia ratio

Inertia is like the force to retain the current moving condition. Inertia ration is calculated by dividing load inertia by rotor inertia. Generally, for motor with 750W or lower capacity, the inertia ratio should be “10” or less. For motor with 1000W or higher capacity, the inertia ratio should be “10” or less. If the system need quicker response, a lower inertia ratio is required.

10.2 General inertia calculation for various rigid objects of uniform composition

| Shape | J calculation formula | Shape | J calculation formula |
|--|-----------------------------------|--|---------------------------------|
| Disk  <small>D2-DNN37A</small> | $J = \frac{1}{8} MD^2$ | Separated rod  <small>D2-DNN41A</small> | $J = \frac{1}{8} MD^2 + MS^2$ |
| Solid cylinder  <small>D2-DNN38A</small> | $J = \frac{1}{8} MD^2$ | Straight rod  <small>D2-DNN42A</small> | $J = \frac{1}{3} ML^2$ |
| Hollow cylinder  <small>D2-DNN39A</small> | $J = \frac{1}{8} M(D^2 + d^2)$ | Prism  <small>D2-DNN43A</small> | $J = \frac{1}{12} M(a^2 + b^2)$ |
| Uniform rod  <small>D2-DNN40A</small> | $J = \frac{1}{48} M(3D^2 + 4L^2)$ | | |

List of symbol :

- J : Inertia [kg·m²]
- M : Mass [kg]
- D : Outer diameter [m]
- d : Inner diameter [m]
- L : Length [m]
- a, b, c : Side length [m]
- S : Distance [m]

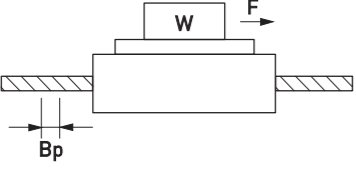
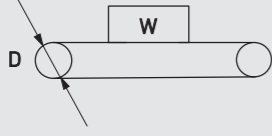
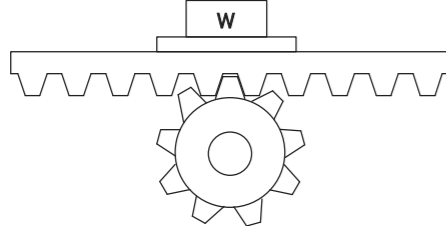
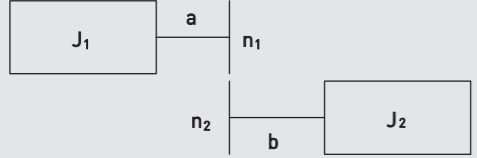
If mass [M [kg]] is unknown, calculate it with the following formula :

Mass M[kg] = Density ρ [kg/m³] x Volume V[m³]

Density of each material

- Iron ρ = 7.9 x 10³ [kg/m³]
- Brass ρ = 8.5 x 10³ [kg/m³]
- Aluminum ρ = 2.8 x 10³ [kg/m³]

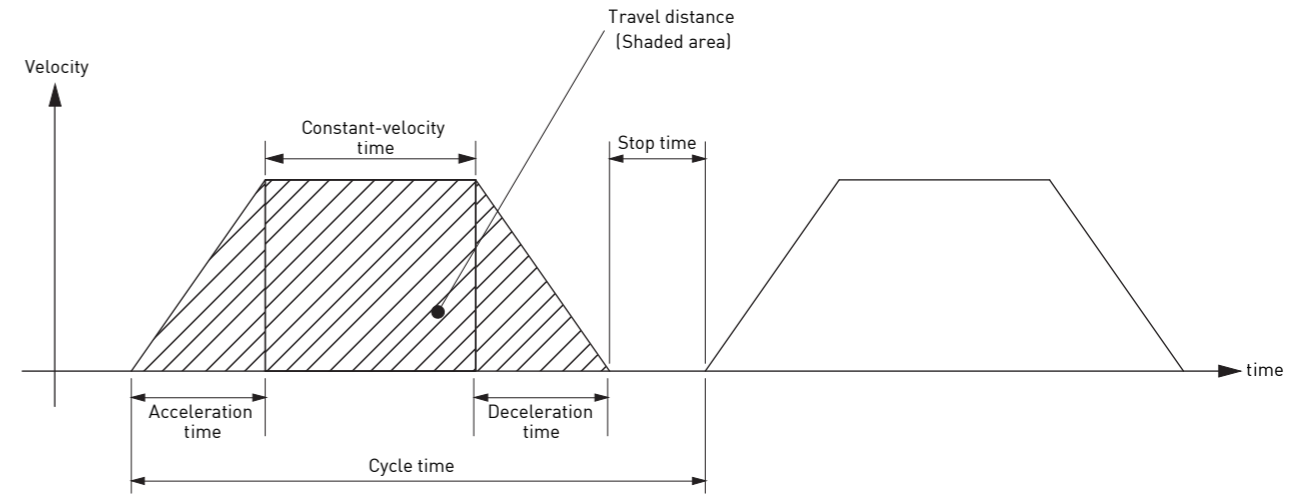
10.3 Equivalent inertia calculation for mechanism

| Mechanism | J calculation formula |
|---|--|
| Ball screw  | $J = J_B + \frac{MB_P^2}{4\pi^2}$ |
| Belt(Conveyor)  | $J = \frac{1}{4} W_b D^2$ *Excluding drum J |
| Rack and pinion  | $J = J_p + (M_r + W_r) \frac{D^2}{4}$ |
| Reduction gear  | $J = J_1 + \left(\frac{n_2}{n_1}\right)^2 J_2$ Inertia on shaft "a" |

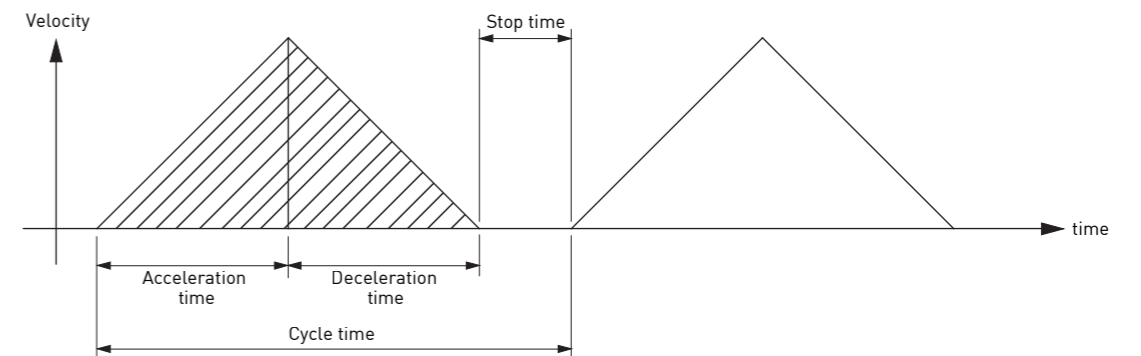
- List of symbol:
 J : Inertia [kg-m²]
 J_B : J of ball screw
 J_P : J of pinion
 M : Mass [kg]
 M_r : Mass of rack [kg]
 W_b : Workpiece weight on belt [kg]
 W_r : Workpiece weight on rack [kg]
 P : Lead
 D : Drum diameter [m]
 n₁ : A rotational speed of a shaft [r/min]
 n₂ : A rotational speed of b shaft [r/min]

10.4 Operating pattern (motion velocity profile)

■ Trapezoidal profile

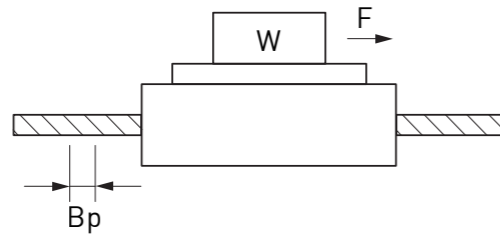


■ Triangle profile

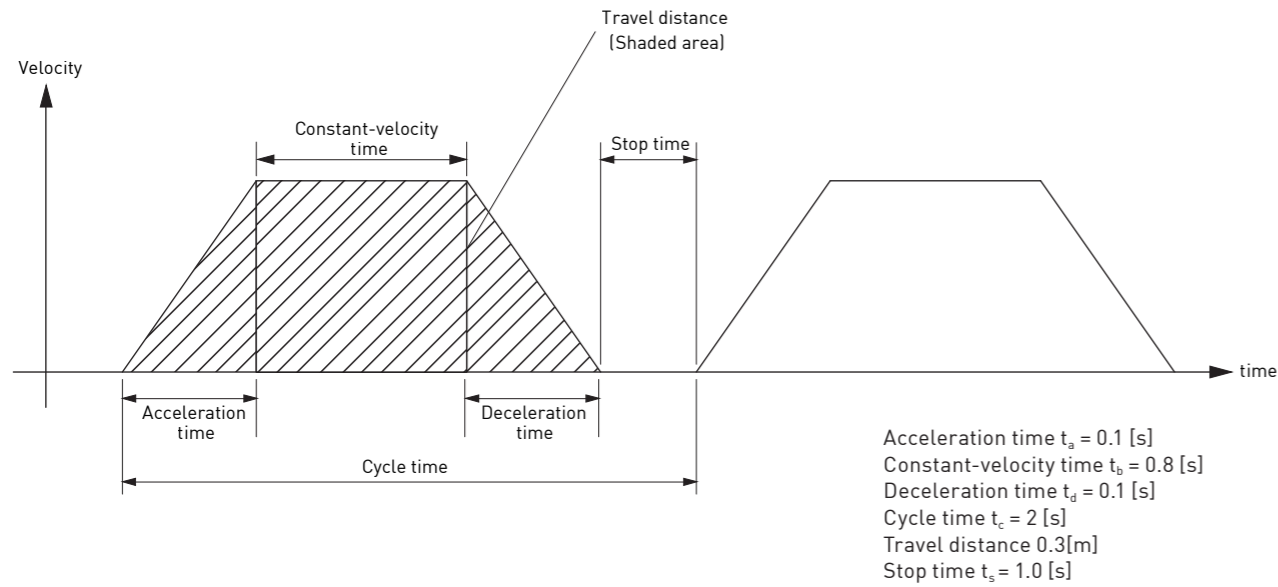


10.5 Motor selection example - ballscrews mechanism

Workpiece weight $W = 5$ [kg]
 Ball screw length $B_L = 0.5$ [m]
 Ball screw diameter $B_D = 0.02$ [m]
 Ball screw lead $B_P = 0.02$ [m]
 Ball screw efficiency $B_{eff} = 0.9$
 Travel distance 0.3 [m]
 Coupling inertia $J_C = 10 \times 10^{-6}$ [kg-m²]



■ Running pattern(velocity profile)



■ Ball screw weight

$$B_W = \rho \times \pi \times \left(\frac{B_D}{2}\right)^2 \times B_L$$

$$= 7.9 \times 10^3 \times \pi \times \left(\frac{0.02}{2}\right)^2 \times 0.5$$

$$= 1.24 \text{ [kg]}$$

■ Load inertia

$$J_L = J_C + J_B + J_W = J_C + \frac{1}{8} B_W \times B_D^2 + \frac{W \times B_P^2}{4 \pi^2}$$

$$= 0.00001 + \frac{1.24 \times 0.02^2}{8} + \frac{5 \times 0.02^2}{4 \pi^2}$$

$$= 1.226 \times 10^{-4} \text{ [kg-m}^2\text{]}$$

■ Provisional motor selection

Choose Hiwin 200W Servo motor : $J_M = 0.17 \times 10^{-4}$ [kg -m²]

■ Calculation of inertia ratio

$$\frac{J_L}{J_M} = \frac{1.226 \times 10^{-4}}{0.17 \times 10^{-4}} = 7.21$$

The inertia ratio is less than 10.

■ Calculation of maximum velocity (Vmax)

$$\frac{1}{2} \times t_a \times V_{max} + t_b \times V_{max} + \frac{1}{2} \times t_d \times V_{max} = \text{Travel distance}$$

$$\frac{1}{2} \times 0.1 \times V_{max} + 0.8 \times V_{max} + \frac{1}{2} \times 0.1 \times V_{max} = 0.3$$

$$V_{max} = 0.334 \text{ [m/s]}$$

■ Calculation of motor velocity (N [r/min])

Ball screw lead $B_P = 0.02$ [m]

$$N = \frac{V_{max}}{B_P} = \frac{0.334}{0.02} = 16.7 \text{ [rps]} = 1002 \text{ [rpm]}$$

1002[rpm] is less than 3000[rpm] (rated velocity of Hiwin 200W Servo motor)

12. Safety Precautions

Thank you for purchasing HIWIN's AC servo motor. Installation and operation of the motor must be in accordance with the HIWIN manual. Before using the servo motor, please read these safety instructions and precautions carefully.

■ Unpacking instructions

1. Before using the servo motor, please read these safety instructions and precautions carefully. HIWIN is not responsible for any damage, accident, or injury caused by incorrect handling.
2. Examine the appearance of the motor for any unusual marks or damage from shipment.
3. Inspect the wires for damage.
4. Do not disassemble the motor. Since the product design has been based on structure calculations, computer simulations, and prototype testing, do not disassemble the product without the permission of HIWIN engineers.
5. Supervise children when handling this product.
6. People with psychosomatic illness or insufficient experience should not handle this product, unless under the direct supervision of managers or product narrators.

* If any items are damaged or incorrect, please contact your distributor or HIWIN sales representative.

■ Safety instructions

1. The product can only be repaired by HIWIN engineers. Please send the product back to us if there is any unusual phenomenon.
2. Do not hold the motor by its wire harness or shaft.
3. Do not hit the motor or shaft. Shock can damage the encoder inside the motor.
4. Do not apply loads to the motor shaft that are in excess of the specified value.
5. Protect the motor and encoder from high electrical noise, vibration, and unusual temperatures.
6. Do not change the motor parts or disassemble the screws. HIWIN will not be responsible for any damages, injuries, or accidents that may occur.

■ Wiring instructions

1. Ensure the specified power input value before using the product, and verify that the proper power supply is being used.
2. Before operation, please ensure that the motor, brake, and encoder are connected correctly. Incorrect wiring may cause abnormal motor operation or even cause permanent damage to the motor.
3. To avoid voltage coupling and electrical noise on the encoder, ensure adequate separation of the motor power wires and the encoder wires.
4. Ensure that the motor ground wire is connected to the ground terminal on the servo drive.
5. Do not perform a dielectric voltage-withstand test on any encoder terminal. The test may cause damage to the encoder.

■ Operation instructions

1. Higher than maximum specified current may cause demagnetization of magnetic components inside the motor.
2. The AC servo motor is designed to operate through a dedicated servo drive. Do not connect to a commercial power source (100/200V AC, 50/60 HZ). The motor will not operate correctly and may cause permanent damage.
3. The motor must be operated within its specified range.

4. Attention should be given to ensure adequate cooling and ventilation of the motor during operation.
5. For long term use, the motor shaft should be resupplied with proper and sufficient oil during the period of operation.
6. If any abnormal odor, noise, smoke, temperature rises or vibration is detected, stop the motor immediately. Remove power from the servo drive and isolated the motor.


■ Motor International Standard


| | | Drive | Motor |
|---------------------|------------------------|--|---------------------------------------|
| CE Directives CE | EMC Directives | EMC: EN61800-3 EN55011 EN61000-6-2 EN61000-6-4 EN61000-2-4 IEC60146-1-1 IEC61000-2-1 | EN55011 EN61000-6-2 EN61000-6-4 |
| | Low-Voltage Directives | LVDS: EN61800-5-1 | EN60034-1 EN60034-5 |
| UL Directives | | UL: E348161 (D2T 100W/400W/1000W) | UL1004-1 UL1004-6 |

■ Maintenance and Storage instructions

1. Do not store the product in an inflammable environment or with chemical agents.
2. Store the product in a place without humidity, dust, harmful gases, or liquids.
3. The motor shaft opening is neither waterproof nor oil-proof. Do not install the motor in an environment where there is harmful gas, liquid, excessive moisture, or water vapor.
4. Do not store the servo motor where it will be subjected to vibration or shock in excess of the specified limit.
5. The storage and transportation temperature of this product: $-20^{\circ}\text{C}\sim+65^{\circ}\text{C}$
6. Clean : Wipe with Alcohol (70%)
7. Before shipping, the motor shaft is coated with antirust oil to protect the motor shaft against rust formation. However, the material of the motor shaft is not entirely rust-proof. When the motor storage time has exceeded six months, please inspect and examine the motor shaft and resupply with proper and sufficient antirust oil at least once every three months thereafter.
8. Product disposal : Follow the local laws and regulations for recycling.

A one year guarantee is provided from the date of delivery. For product damage caused by improper operation (Please refer to the notes and instructions in this operation manual). HIWIN will not be held responsible for replacing or maintaining the product as a result of any natural disasters that may occur during this period.

 Warning : For the proper use of the HIWIN AC servo motor read these safety precautions carefully before installation, operation, and maintenance.

 Warning : Do not touch when motor operating to avoid being scalded.

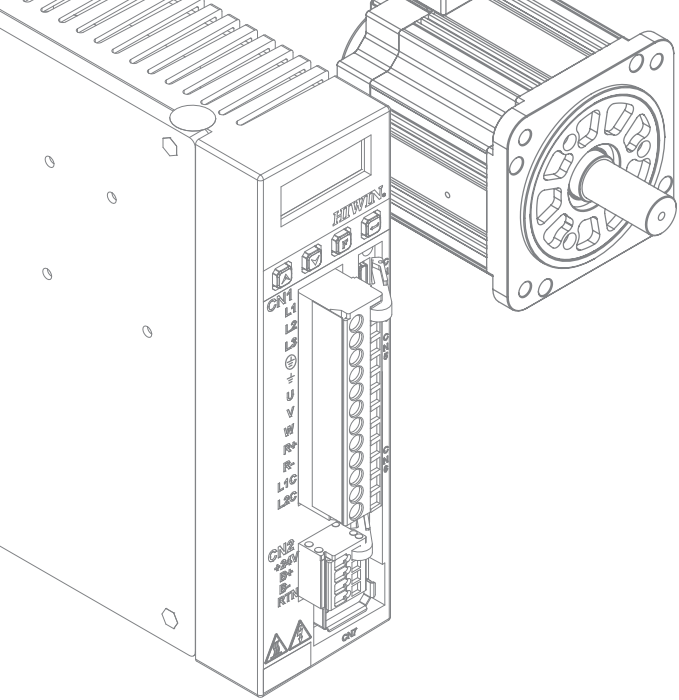
- Please read "warning signs".
- Turn power off before clean product.
- Read manual before use.
- If the product is used under overload condition shell temperature rises.
- Without manufacturer's permission, please do not arbitrarily modify the device.
- It is difficult to ensure electromagnetic compatibility (EMC) problems do not occur in some environments.
- Removal of damaged power cable fasteners, with care and with attention for power cable fasteners.
- Avoid impact on of shaft end and encoder.
- Products cannot be used in environment with flammable materials.

AC Servo Motor & D2 Drive Technical Information

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1. HIWIN is the registered trademark of HIWIN Mikrosystem Corp.. For your protection; To avoid counterfeit products, be certain you are buying genuine HIWIN products before purchase.
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