

NACHI

Standard specifications

NB04L-02-FD11

4th edition

NACHI-FUJIKOSHI CORP.

1307, SNBEN-046-004, 001

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Chapter 1 NB04L-02 Configuration

1.1 NB04L-02 standard System

1.1.1 FD-B4L Basic Configuration

Table 1.1.1 NB04L-02 basic configuration

| Reference Number and Parts Name | Model Type | Specifications |
|--|---------------------------------------|--|
| ① Manipulator | NB04L-02 (Model Type: NB04L-○△-02) | ○ None = Floor-mount C = Ceiling-mount W = Wall-mount △ None : Except for China and Taiwan CN = China and Taiwan |
| ② Controller | FD11 (Model Type: FD11-FL□***) | For NB04L, NV06L □ : No External Axis P : External 1 Axis 2 : External 2 Axes 4 : External 1 Axis x 2 A : Large-capacity External 1 Axis (Standard Case External Axis Spec.) *** : Expansion Case Spec. |
| ③ Teach pendant | FDTDFSJN-□L** | □ : Global icons 3 : Icons with Chinese characters ** : 08 8m Spec. (Standard) 15 15m Spec. |
| ④ Operation Box (Note 1) | FDOP-00** | ** : 05 5m Spec. (Standard) 10 10m Spec. 15 15m Spec. |
| ⑤ Control Cable 1, 3 (Wire Harness) | FDRB-10** | ** : 05 5m Spec. (Standard) 10 10m Spec. 15 15m Spec. |

(Note 1) In case of not using the operation box, a “connection terminal block” and “selector switch assembly” are required for mode selection. For details, refer to section 2.2.6 (4).

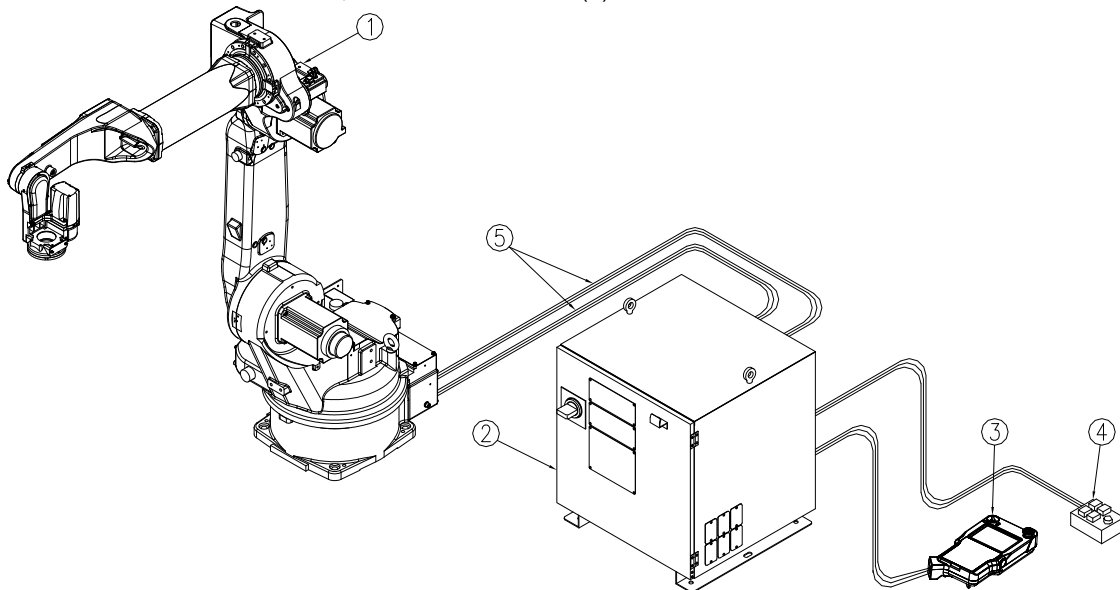


Fig. 1.1.1 NB04L-02 basic configuration

1.1.2 Components of Controller and Welding Power Supply Peripherals (for D series)

Table 1.1.2 Components of Controller and Welding power supply Peripherals (for D series)

| Reference Number and Parts Name (Note 1) | Model Type | Specifications |
|---|------------|---|
| ① Control Cable 5 | FDRB-51□□ | □□ : 05 5m Spec. (Standard) 10 10m Spec. 15 15m Spec. |
| ② Cable Hose Group (Note 2) | A2RB-4△□□ | △ : 1 DM350, DP350, DR350 4 DM500, DP500, DP400R 6 DL350 □□ : 05 5m Spec. (Standard) 10 10m Spec. 15 15m Spec. |
| ③ Gas Flow Regulator | FCR-226 | For CO2 Welding |
| | RF-16D | For MAG Welding (Argon) |
| ④ Water Tank | PU-301 | Required when using 500A Welding power supply |
| ⑤ CAN I/F Board | L9129C | For DM |
| | L20365A | For DR, DL and DP |
| | L20809A | For DP-400R |
| ⑥ Voltage Detecting Cable (- Side) (Note 3) | L9509□ | □ : B 5m Spec. (Standard) C 10m Spec. D 15m Spec. |

(Note 1) Please refer to Fig. 1.1.2 for component reference number.

(Note 2) Gas hose, torch side welding cable, work side welding cable and control cable 4 are contained in the Cable hose group.

(Note 3) Voltage detecting cable (- side) is required when DL series are used.

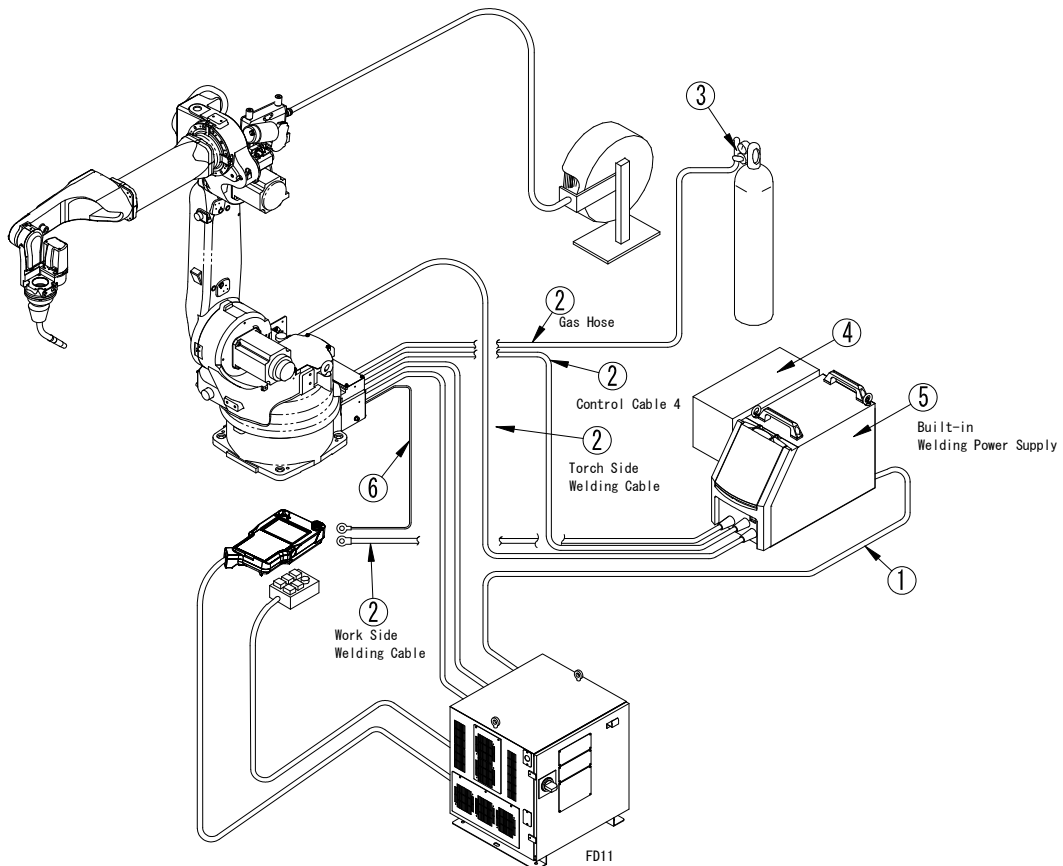


Fig. 1.1.2 Components of Controller and Welding power supply Peripherals (for D series)

1.1.3 Components of Controller and Welding Power Supply Peripherals (for Welbee Inverter series)

Table 1.1.3 Components of Controller and Welding power supply Peripherals (for Welbee Inverter series)

| Reference Number and Parts Name (Note 1) | Model Type | Specifications |
|---|------------|---|
| ① Control Cable 5 | FDRB-52□□ | □□ : 05 5m Spec. (Standard) 10 10m Spec. 15 15m Spec. |
| ② Cable Hose Group (Note 2) | A2RB-46□□ | □□ : 05 5m Spec. (Standard) 10 10m Spec. 15 15m Spec. |
| ③ Gas Flow Regulator | FCR-226 | For CO2 Welding |
| | D-BHN-2 | For MAG Welding (Argon) |
| ④ Voltage Detecting Cable (- Side) (Note 3) | L9509□ | □ : B 5m Spec. (Standard) |
| | | C 10m Spec. |
| | | D 15m Spec. |
| ⑤ Software | L22153F | M350L mode |

(Note 1) Please refer to Fig. 1.1.3 for component reference number.

(Note 2) Gas hose, torch side welding cable, work side welding cable and control cable 4 are contained in the Cable hose group.

(Note 3) This software is required when WB-M350L is used.

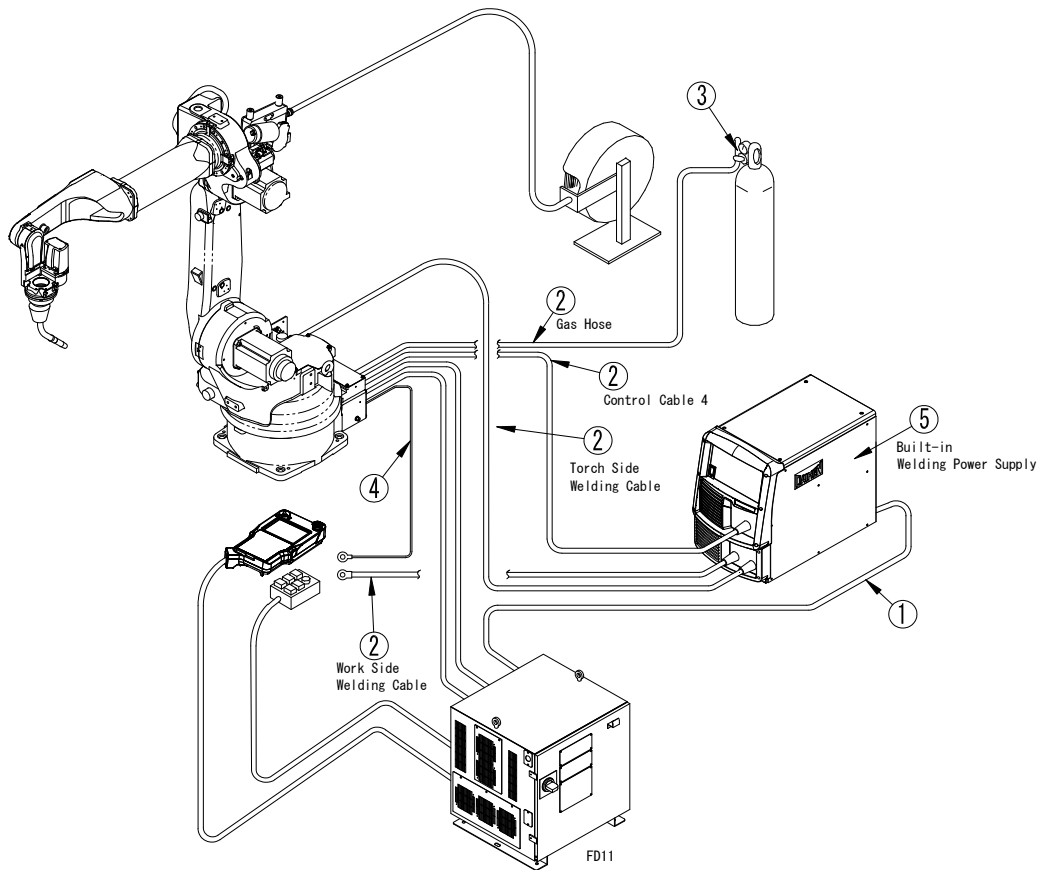


Fig. 1.1.3 Components of Controller and Welding power supply Peripherals (for Welbee Inverter series)

1.1.4 Component of Robot Peripheral

Table 1.1.4 Component of Robot Peripheral (Note1)

| Reference Number and Parts Name (Note 1) | Model Type | Specifications |
|--|--|---|
| ① Shock Sensor | SSB | Shock Sensor for Manipulator, Type B (Note2) |
| ② CO ₂ /MAG Welding Torch | RT3500H | Air Cooled 350A 45° Curved Torch (Welding power supply of Rating Output Current: 350A, Standard) |
| | RTW5000H | Water Cooled 500A 45° Curved Torch (Welding power supply of Rating Output Current: 500A, Standard) |
| ③ Tip Gauge | L317X | Welding power supply: Rating Output Current: 350A (RT3500* For Torch, Wire Extrusion of 15mm) |
| | L10319H | Welding power supply: Rating Output Current, 500A (RTW5000* For Torch, Wire Extrusion of 20mm) |
| ④ Robot Gauge | L10618B | (Option) For the checking of positional gap of the robot |
| ⑤ Wire Feeding Unit | AF-4011 (For D series / Welbee Inverter series) | Welding Method : CO ₂ /MAG Material : Iron Feeding Speed : 1.5 ~ 22m/min. Encoder : Yes Roll : Four Rolls (Standard) |
| ⑥ Fixing Bracket | L10680A (For AF-4011) | Common with Type NB manipulator (Including Gas EM Valve) |
| ⑦ Coaxial power cable | L-10641 | Cable Length: 1.1m (Standard) |
| | L-10651 | Specification with voltage detection cable of L-10641 (For DL-350 or WB-M350L) |
| ⑧ Wire Reel Stand | L10085A | Floor Rest Type (Standard) |
| | L10675A | Mounting on Body Type |
| ⑨ Conduit | L10597D | Floor Rest Type with 3m Cable Length (Standard) |
| | L10597C | Mounting on Body Type with 1.8m Cable Length |

(Note 1) Please refer to Fig. 1.1.4 for component reference number.

(Note 2) In case of a shock sensor not connected, connect the short connector (L21766C00 : optional) to CNMCH on the front of IPM drive unit.

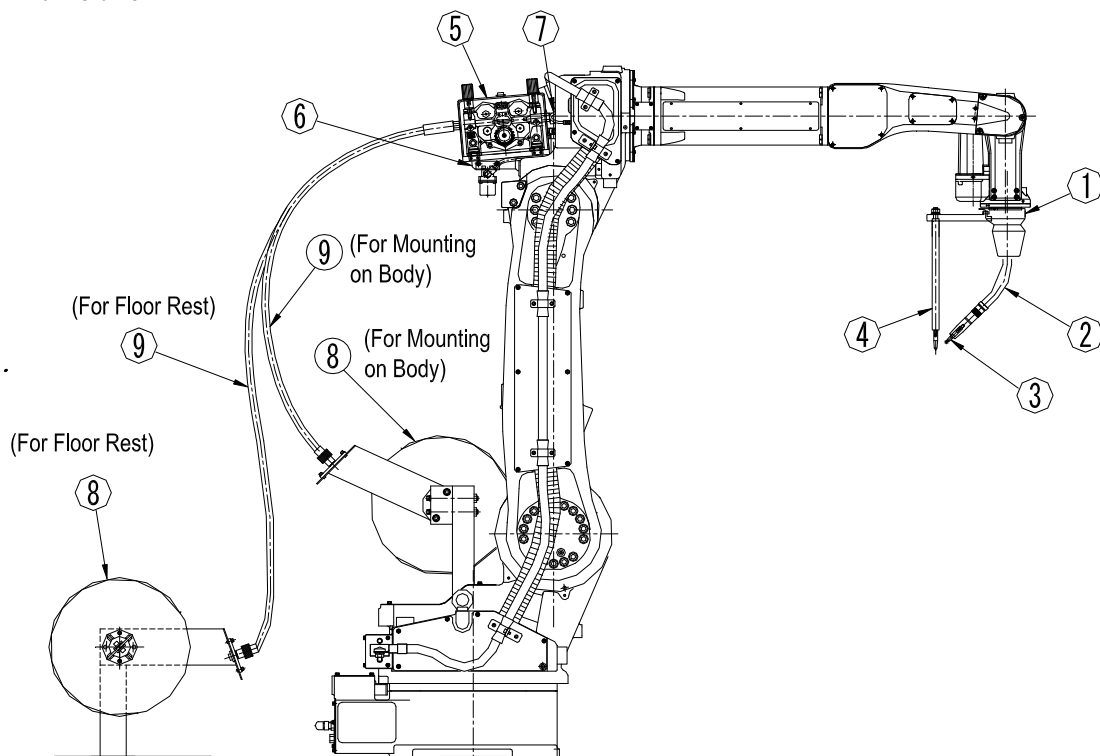


Fig. 1.1.4 Components of Robot Peripheral

Chapter 2 NB04L-02 Basic Specifications

2.1 Specifications of NB04L-02 Manipulator

2.1.1 Basic Specifications

Table 2.1.1 NB04L-02 manipulator basic specifications

| Item | | Specifications | |
|------------------------------------|-----------------------------|---|--|
| Name | | NB04L-02 | |
| Structure | | Vertical articulated type | |
| Number of axes | | 6 | |
| Max. payload capacity | | 4 kg | |
| Positional repeatability | | +/- 0.08 mm (Note 1) | |
| Drive system | | AC Servo motor | |
| Drive capacity | | 4650W | |
| Position feedback | | Absolute encoder | |
| Working range | Arm | Axis J1 (Revolving) | +/- 170° (+/-50°) (Note 2) |
| | | Axis J2 (Lower arm) | -155°~ +100° (Note 5) |
| | | Axis J3 (Upper arm) | -170°~ +190° |
| | Wrist | Axis J4 (Swing) | +/- 155° |
| | | Axis J5 (Bending) | -45°~ +225°(Note 4) |
| | | Axis J6 (Twist) | +/- 205° (Note 4) |
| Max. velocity | Arm | Axis J1 (Revolving) | 3.40 rad/s {195°/s} (3.05rad/s{175°/s})(Notes 2) |
| | | Axis J2 (Lower arm) | 3.49 rad/s {200°/s} |
| | | Axis J3 (Upper arm) | 3.49 rad/s {200°/s} |
| | Wrist | Axis J4 (Swing) | 7.33 rad/s {420°/s} |
| | | Axis J5 (Bending) | 7.33 rad/s {420°/s} |
| | | Axis J6 (Twist) | 10.5 rad/s {600°/s} |
| Wrist load | Allowable Moment | Axis J4 (Swing) | 10.1 N*m |
| | | Axis J5 (Bending) | 10.1 N*m |
| | | Axis J6 (Twist) | 2.94 N*m |
| | Allowable moment of inertia | Axis J4 (Swing) | 0.38 kg*m ² |
| | | Axis J5 (Bending) | 0.38 kg *m ² |
| | | Axis J6 (Twist) | 0.03 kg *m ² |
| Arm operation cross-sectional area | | 6.37 m ² x 340° | |
| Ambient conditions | | 0 ~ 45°C, 20 ~ 80 %RH (No condensation) | |
| Mass (weight) | | 277 kg | |
| Upper arm payload capacity | | 20 kg (Note 3) | |
| Installation type | | Floor, ceiling or wall hanging type | |
| Paint color | | White (Munsell 10GY9/1) | |

- Note) 1. The value of the positional repeatability is at the tool center point (TCP) compliant to ISO 9283.
 2. The value in the parentheses indicates the wall-hung condition.
 3. When loading the Max. payload capacity as the end effector. For details, refer to section 2.1.7.
 4. There are occasions where restrictions can be made to the operation range of the J6 axis, depending on the J5 axis's posture.
 5. There are occasions where restrictions can be made to the operation range of the J2 axis.



IMPORTANT

- The value of the positional repeatability is at the tool center point (TCP) compliant to ISO 9283.
- The positional data of absolute encoder is backed up by the battery. The battery backup period with the primary power OFF is approx. 3 years.
Exceeding this period will require the battery replacement and the absolute offset adjustments.
- The battery backup period may be shorter depending on the environmental conditions, the use conditions and so on.
- A holding brake is provided in all axes.
- The robot itself or peripheral jigs can be cause of interference according to their postures. Please be careful about any interference when you teach the robot.
- The above specifications are subject to change without notice.

2.1.2 Outside Dimensions and Working Range

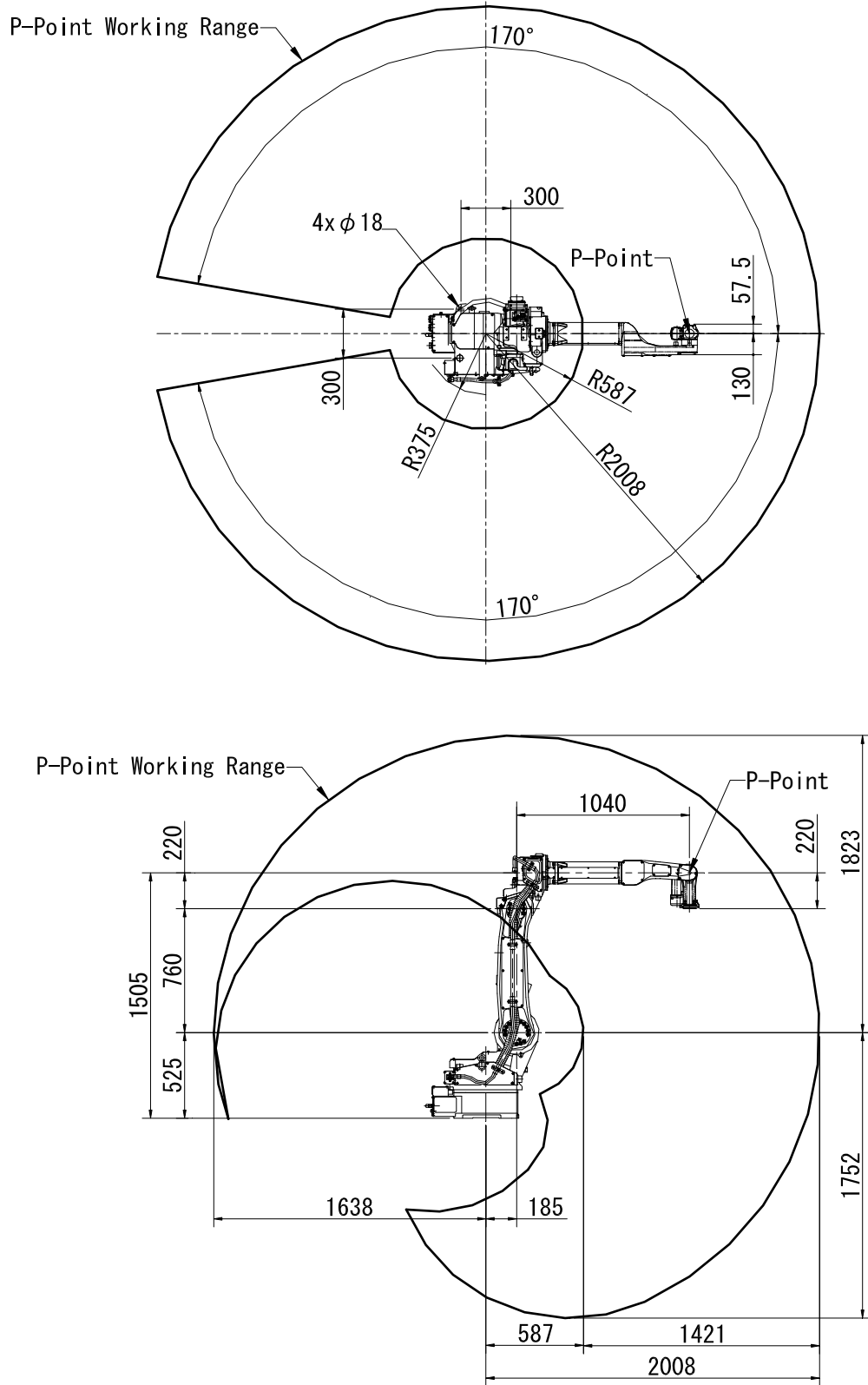


Fig. 2.1.1 Outside Dimensions and Working Range of NB04L-02 (unit : mm)

2.1.3 Allowable Load on Wrist Axis

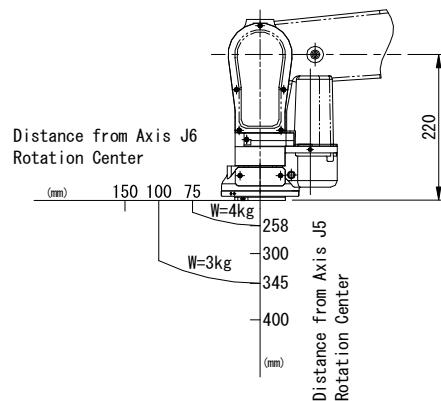
The payload of manipulator must not exceed max. payload capacity 4kg, including a welding torch, a chucking tool in handling and a workpiece.

Mounting a standard welding torch does not cause any problems to the manipulator, but both the moment and the moment of inertia must be within the allowance stated in the table below when the manipulator is used for handling or any other similar purposes.

Also, when a load is imposed not in the form of mass but force, a wrist axis must not be used with these maximum allowable values exceeded.

Table 2.1.2 Allowable Load on Wrist Axis

| Axis Name | NB04L-02 | |
|-----------|------------------|-----------------------------|
| | Allowable Moment | Allowable Moment of Inertia |
| Axis J4 | 10.1 N*m | 0.38 kg *m ² |
| Axis J5 | 10.1 N*m | 0.38 kg *m ² |
| Axis J6 | 2.94 N*m | 0.03 kg *m ² |



Note: Though the center of gravity shown above fully satisfies the allowable load moment, the allowable moment of inertia is not always satisfied.

Fig. 2.1.2 Allowable Load on Wrist Axis

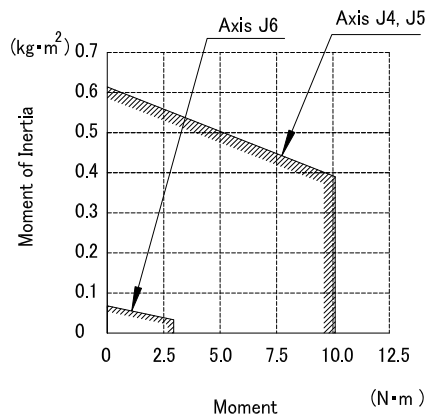


Fig. 2.1.3 Wrist load conditions

2.1.4 Flange Dimensions of Wrist Axis

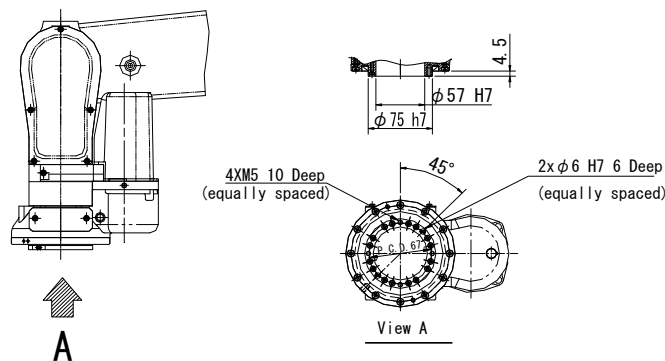


Fig. 2.1.4 Flange Dimensions of Wrist Axis (unit : mm)

2.1.5 Manipulator Installation Dimensions

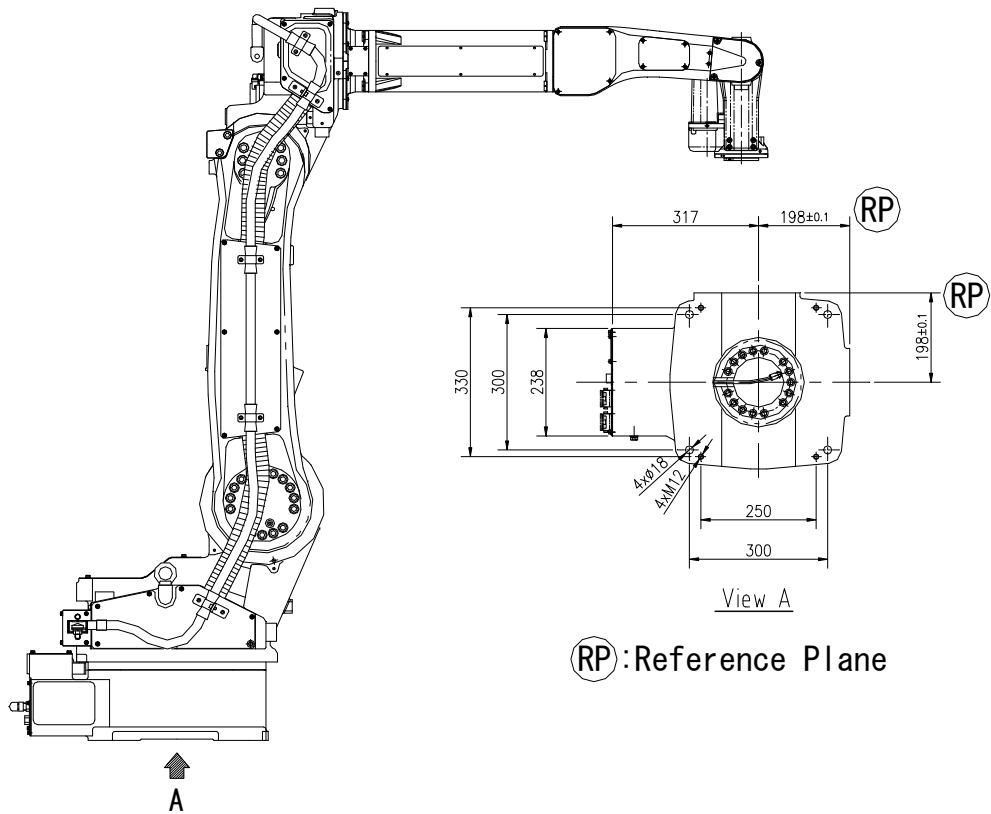


Fig. 2.1.5 Manipulator Installation Dimensions (unit : mm)

2.1.6 Using an Optional Manipulator Stand for Installation

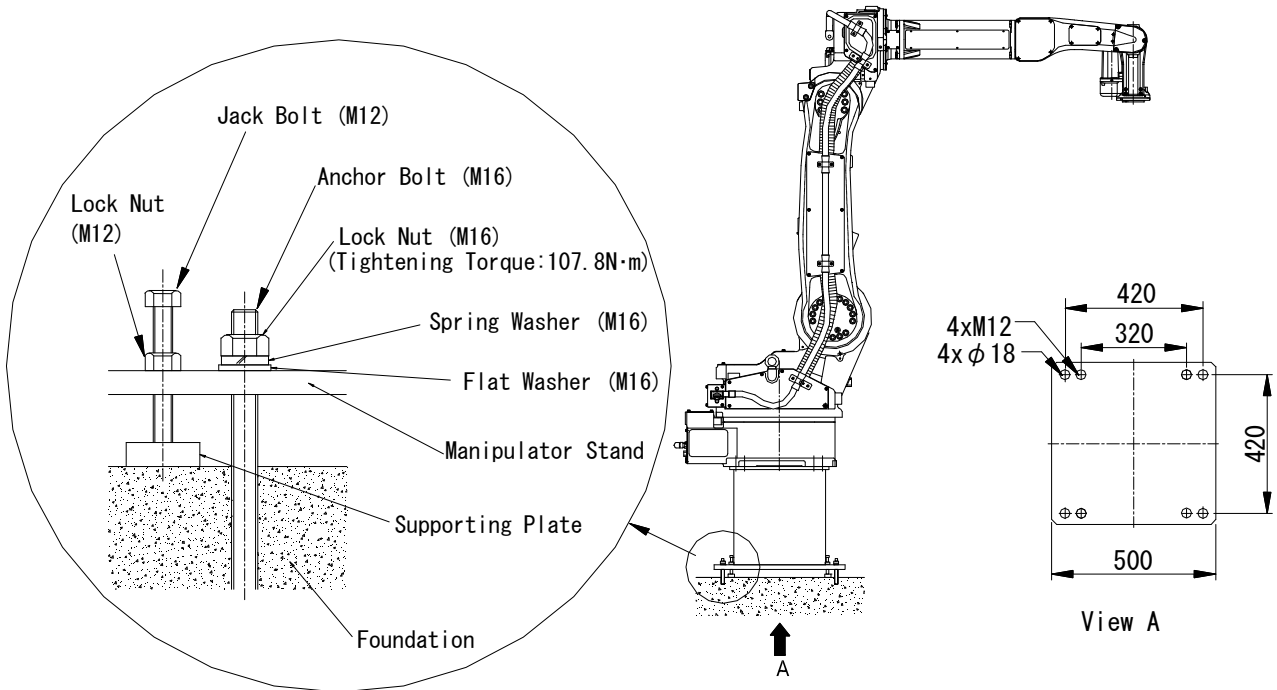


Fig. 2.1.6 Using an Optional Manipulator Stand for Installation (unit: mm)

2.1.7 Mounting Equipment on the Upper Arm

On the top, back and side of the upper arm, there are specific areas prepared for devices such as a wire feeding unit and gas solenoid valve to be mounted. To mount a device, use M8 holes.

- (a) Restriction of the maximum mountable mass on the upper arm.
The max. mountable mass on the upper arm depends on the max. wrist axis payload capacity. Calculate it by the figure below, not exceeding the value "C".

$$A + B_1 + B_2 \leq C$$

A : Max. wrist payload capacity (kg)
B₁ : Mountable mass on the Top of upper arm (kg)
B₂ : Mountable mass on the Back of upper arm (kg)
C : Max. mountable mass (kg)

| | NB04L-02 |
|----------------|-----------|
| A | Max. 4kg |
| B ₁ | Max. 2kg |
| B ₂ | Max. 20kg |
| C | 24kg |

Suppose that the wrist has a mass of 3 kg including a holder. In this case, the upper arm can be mounted with an equipment of 21 kg (total B₁ + B₂) or less.

- (b) The center-of-gravity position for mounting an equipment on the upper arm must be within the 100-mm pitch position of 4XM8 tapping holes.
(When mounting the equipment on the back, be careful not to intervene the area of **NOT-endurable** shown by hatching in the figure below.)

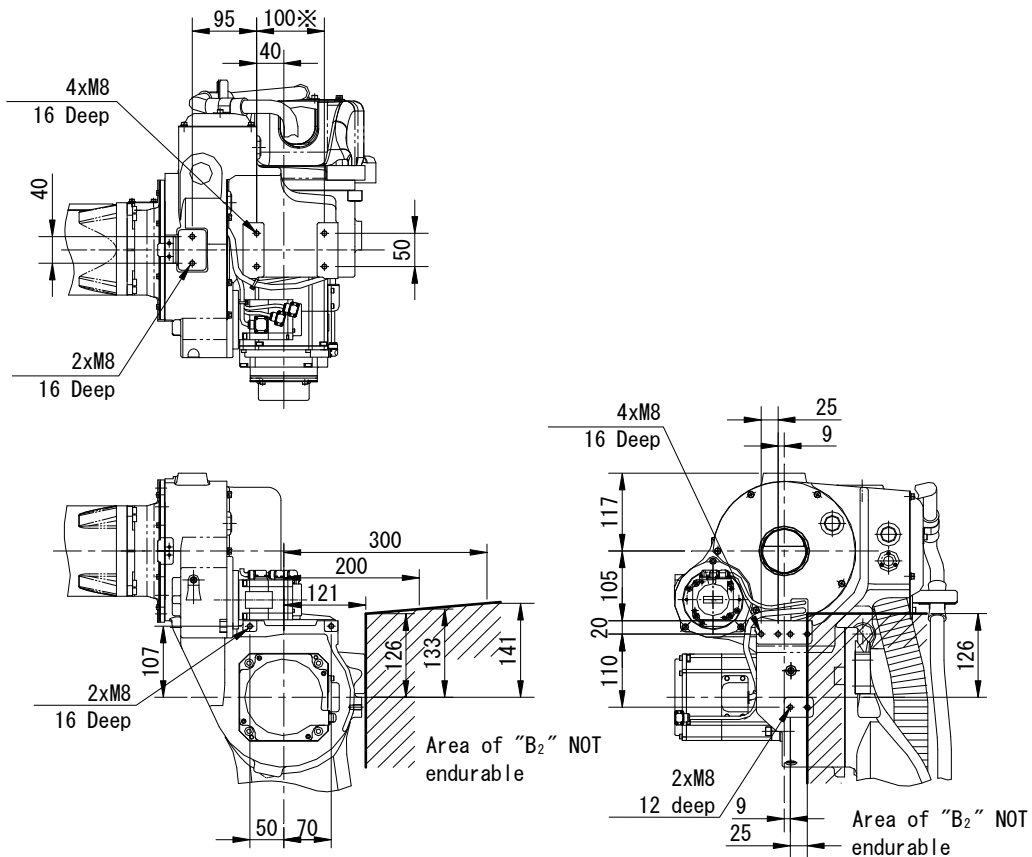


Fig. 2.1.7 Equipment Mounting Position on the Upper Arm of NB04L-02 Manipulator (unit: mm)

2.1.8 Instrument Connecting Cables and Gas (Air) Piping

Inside the manipulator, the instrument connecting cables and a gas (air) hose are built in for a wire feeding unit mounted on top of the upper arm and for driving or signaling instruments such as a gas solenoid valve.

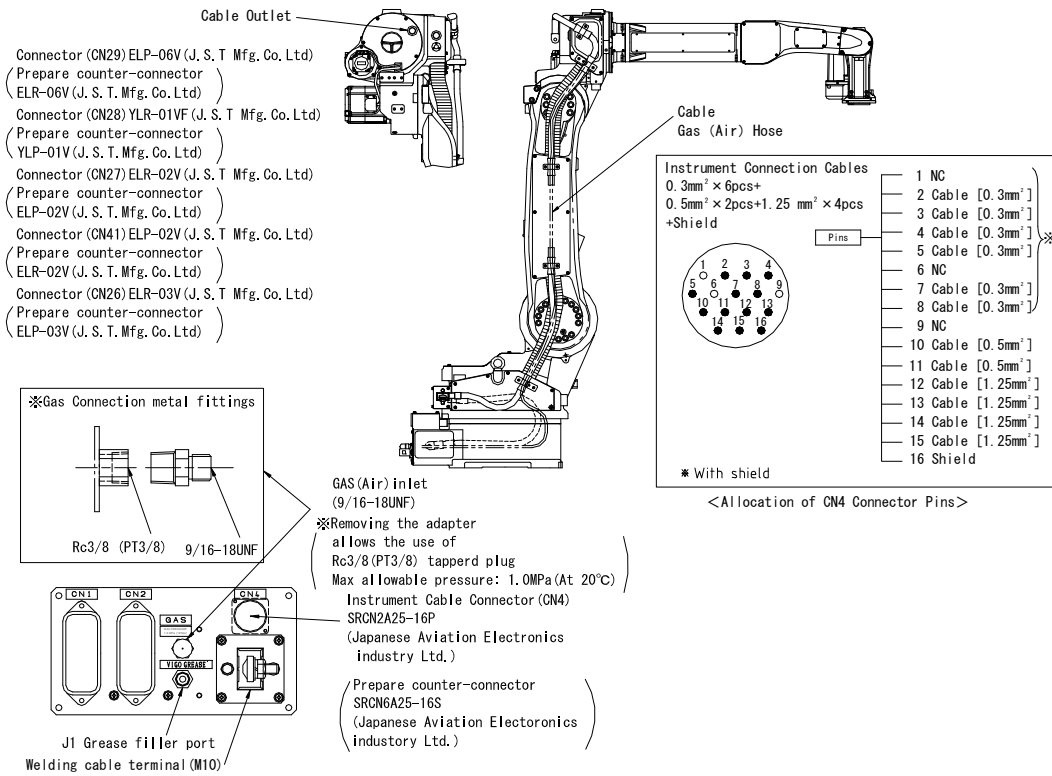


Fig. 2.1.8 Instrument Connecting Cables and Gas (Air) Piping for NB04L-02 Manipulator

For welding application, Fig 2.1.9 below shows the wiring diagram of the built-in cables in the manipulator.

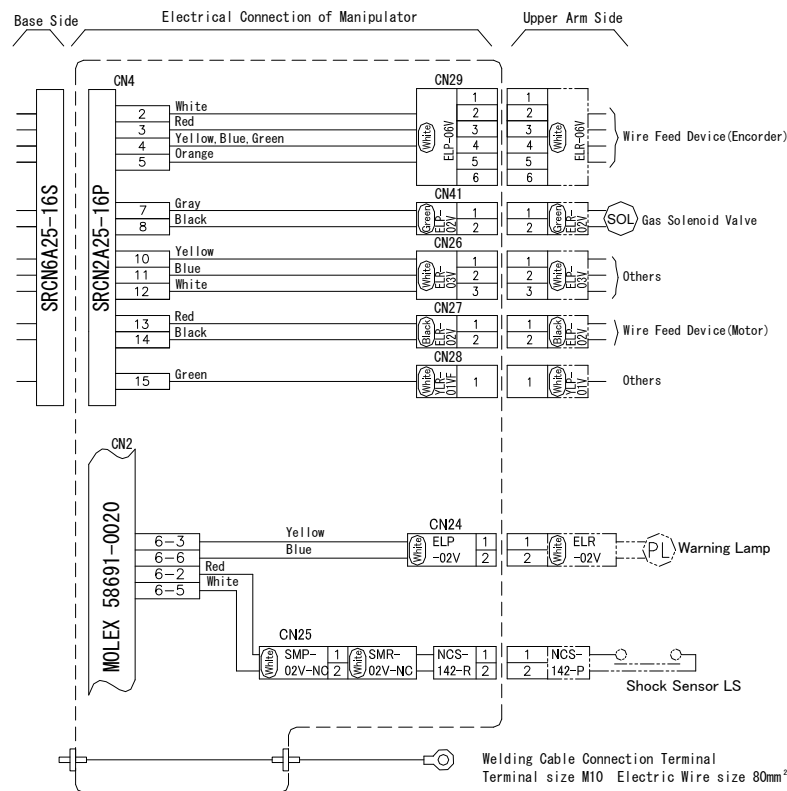


Fig 2.1.9 NB04L-02 Cable Wiring (for welding application)

When using these built-in cables for applications other than welding, prepare the counter-connectors shown from Fig. 2.1.8.

2.2 FD11 Robot controller

2.2.1 Basic specifications

Table 2.2.1 Basic specifications of robot controller

| Item | Specifications | |
|---|---|---|
| Model | FD11-FL0 (For NB04L / NV06L) | |
| Number of control axes (Note 1) | 6 axes (Up to 8 axes can be controlled by built-in extension.) Maximum control axes are up to 32 axes. (However, note that the exterior of controllers with a total of 9 or more axes is a different specification.) (Note 2) | |
| Driving system | AC servo motor | |
| Positional feedback | Absolute encoder | |
| Teaching system | Teaching playback | |
| | Robot language based on JIS SLIM | |
| | IEC61131-3 (Software PLC) (Optional) | |
| Number of task programs | 9,999 | |
| Memory capacity | 160,000 steps (by PTP instruction in a single mechanism) | |
| Teach pendant | 5.7 inch color LCD (640 x 480 pixels, with LED backlight, 65536-color display) Touch panel, Jog dial, one-handed 3-positional enable switch and emergency stop button are included as standard. IP code is IP65. Standard cable length is 8 m. | |
| Operation box | Emergency stop button, Motor on button, Start button, Stop button and Mode select switch are included as standard. Standard cable length is 5 m. | |
| Manipulator connecting cable | Standard cable length is 5 m | |
| I/O Control over External Equipment (Note 3) | Number of Signals | Input 8 points, Output 8 points Extension of input and output is allowed respectively up to 72 points |
| | Input specifications | DC24V 8mA Connect the relay contact (Dry contact) which minimum applicable load is DC24V,5mA, or open-collector device whose leakage current is up to 1mA. |
| | Output specifications | DC24V / AC100V Up to 1A (Minimum applicable load (reference): DC24V, 5mA) |
| External memory I/F | USB memory (Optional) | |
| Structure | Closed structure | |
| Cooling system | Indirect cooling system | |
| Ambient conditions | Temperature: 0 - 45 °C, Humidity: 20 - 80 %RH (Non-condensing) | |
| Primary power | 3-phase AC 200 V / 220 V (+10%, -15%), 50 / 60 Hz | |
| Power consumption | Manipulator | Power capacity (Note 4) |
| | NB04L-02 | 2.4 kVA |
| Grounding | Ground the robot controller separately whose resistance is less than 100 ohms. | |
| External dimensions | W 580 × D 542 × H 650 (mm) | |
| Mass | Approx. 62 kg | |
| Paint color | 10GY9/1, Munsell scale | |

(Note 1) When the capacity of the motor an additional axis is 2kW or more, the number of control axes is limited.

(Note 2) In case that number of control axes exceeds 32, contact us.

(Note 3) The number of I/O can be enlarged to up to 2048 points by installing optional field bus such as CC-link, DeviceNet or Ethernet/IP, etc.

(Note 4) Varies according to the application and operation pattern.

2.2.2 Outside dimensions

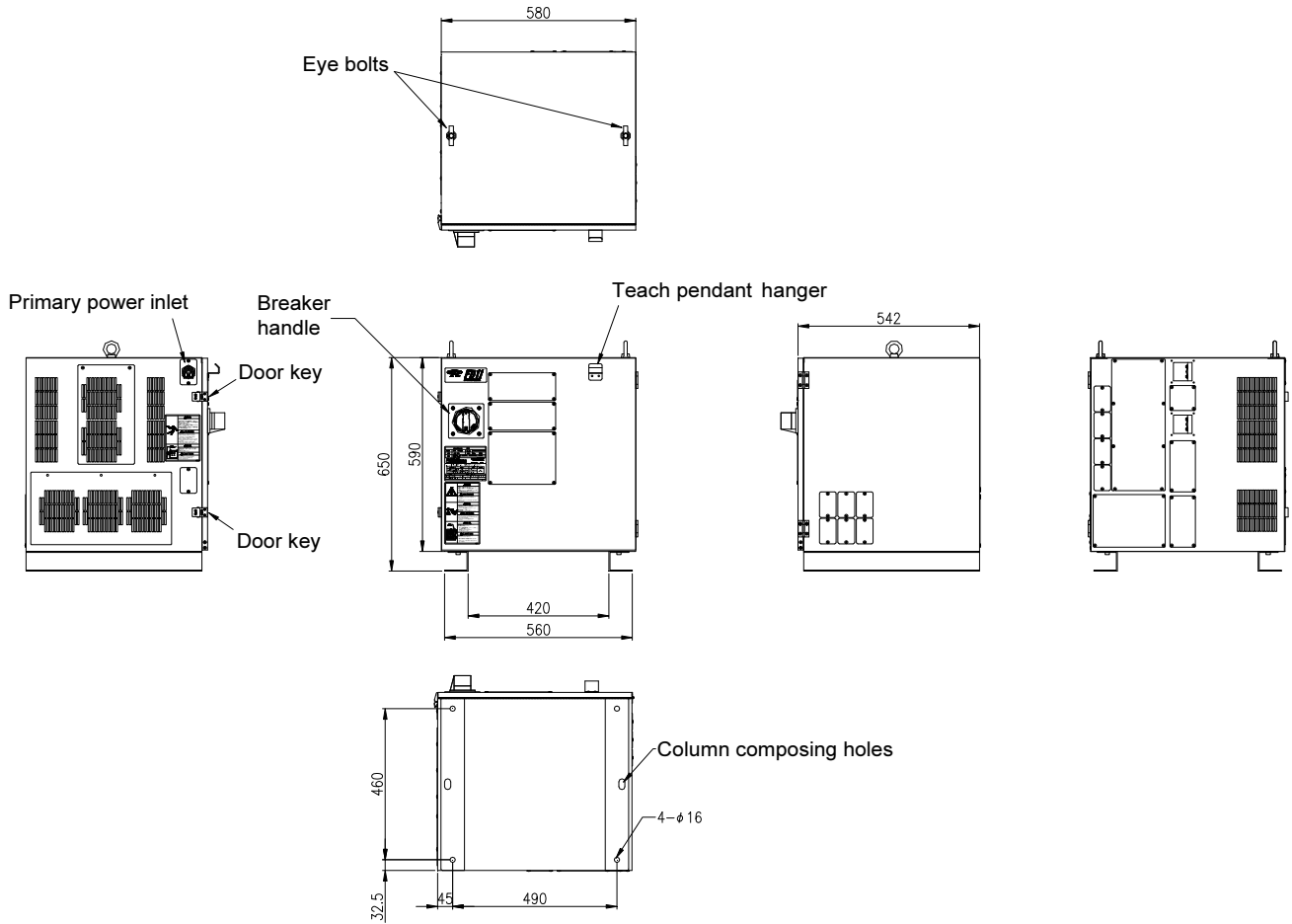


Fig. 2.2.1 Outside dimensions of robot controller (Unit : mm)

2.2.3 Install method of robot controller

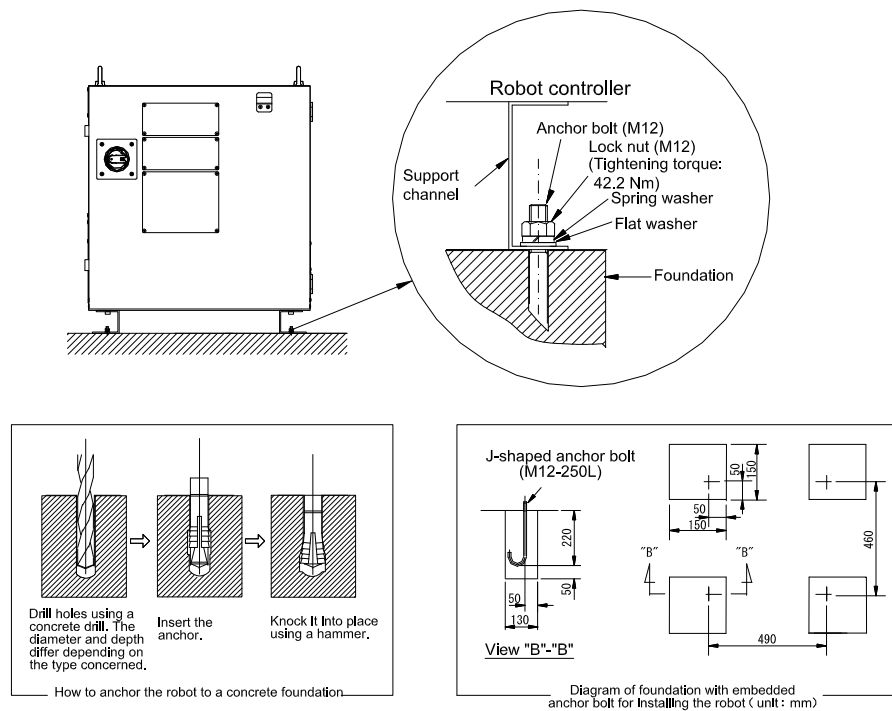


Fig. 2.2.2 Concerning the robot controller installation method (Unit : mm)

2.2.4 External view of Teach pendant

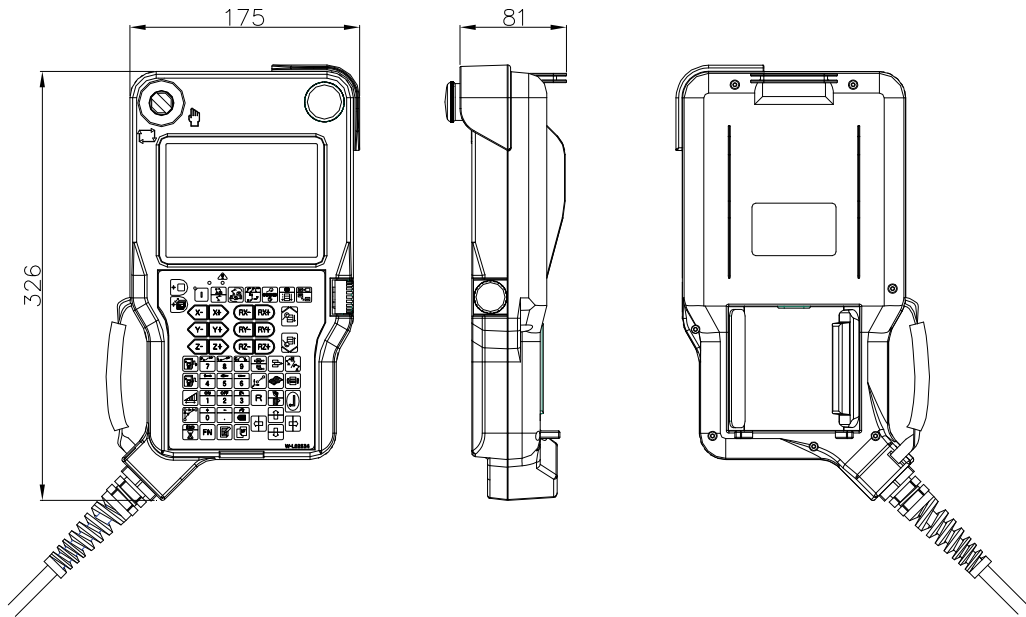


Fig. 2.2.3 External view of Teach pendant (Unit: mm)

2.2.5 External view of operation box and starting box (option)

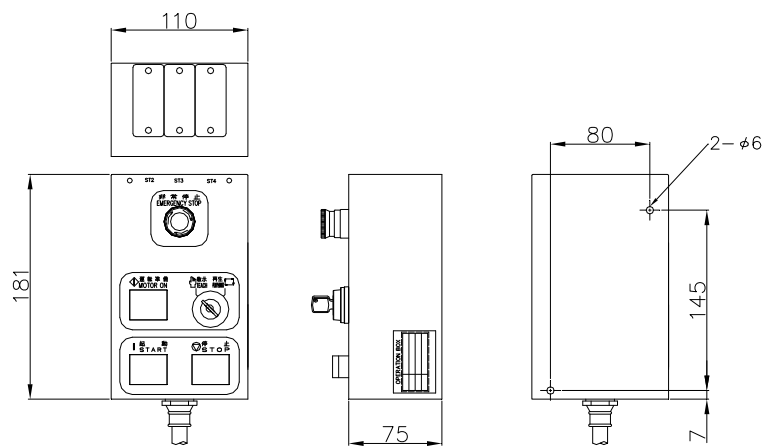


Fig. 2.2.4 External view of operation box (Unit: mm)

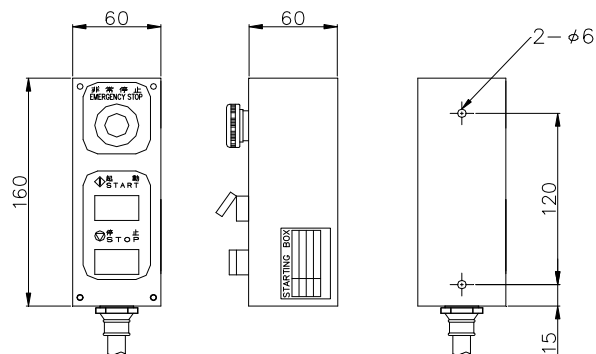


Fig. 2.2.5 External view of starting box (Unit: mm)

2.2.6 FD11 Option

The following products are prepared as option.

Refer to section 1.1.1 for the control cables 1, 3, Teach pendant and the operation box.

(1) Starting box

Emergency stop button, Start button and Stop button are included.

Table 2.2.2 Starting box

| Model | Specifications |
|-----------|------------------|
| FDST-00** | ** : 05 5m Spec. |
| | 10 10m Spec. |
| | 15 15m Spec. |

(2) Relay unit

Eight general physical input and output signals can be used on the arc I/F board as standard specifications.

When 9 or more general physical input points or output one are required, the relay unit is required.

The relay unit is used in combination with the I/O board L21700M00.

A standard physical input specification is common GND (The transistor output of the NPN type can be connected). It is possible to change to a common power supply (The transistor output of the PNP type can be connected) with the accessory cable. When two relay units are used, each accessory cable is required.

Table 2.2.3 Relay unit

| Model | Specifications |
|--|--|
| L22254A (Relay unit #1) L22255A (Relay unit #2) | Number of signals : IN 32 pts. / Out 32 pts. |
| | Input specifications : DC24V 8mA Connect the relay contact (Dry contact) which minimum applicable load is DC24V,5mA, or open-collector device whose leakage current is up to 1mA. |
| | Output specifications : DC24V / AC100V Up to 1A (Minimum applicable load (reference): DC24V, 5mA) |

(3) External starting option

The use of the operation box is recommended for the switch of Teach/Playback mode, even in case of external starting method.

In case of not using the operation box, the parts shown in Table 2.2.4 are required.

Table 2.2.4 External starting option

| Part name | Model | Specifications |
|---------------------------|---------|---|
| Connection terminal block | L21767A | Sequence board CNOP to terminal block TB1 |
| Selector switch assembly | L21768A | Component - Selector switch - Connection cable (15 m) - Cable flange |

(4) External memory USB L21700U00

External memory USB is used to back up user data or upgrade the version.

(5) Step-down transformer L22221A (3kVA) (for NB04 / NV06 / NB04L / NV06L)

For out of the standard primary power voltage (AC200 - 220V).

AC 380/400/420/440/460/480V +/-10%, 3φ 50/60Hz, D grounding

Additional box for transformer is necessary on the standard cabinet. External dimension of controller is changed to W580*D542*H950 mm (not including the height of stand 60mm).

Chapter 3 Scope of supply

Note that users shall be charged for any installation work.

[Example]

- Connection with the robot and robot peripherals, operation check, and welding check with a standard test piece
- Discharging and carrying-in work by using the facilities of either your company or NACHI
- Wiring and piping of the NACHI -manufactured jigs, I/F check, and interlocking trial operation
- Teaching work, welding conditions adjustment, operator education, etc.

In addition, carry out all following works by your company.

- Foundation work of installation location for robot and jigs (including both your company and NACHI manufactured)
- Anchor fixation work, laying iron plate, embedding, concrete construction
- Powering of the robot and jigs (including both your company and NACHI manufactured), primary wiring and piping of the air, and their protection work
- Wiring and piping work for connecting the jig and jig controller prepared by your company with the robot, welding power supply and other peripherals equipment
- Grounding work for the robot, welding power supply, jigs, and jig controller (prepared by both NACHI and your company)

Chapter 4 Note on Installation

The locations in which the manipulator is installed and the method used to install it are critical for ensuring that the functions of the robot will be maintained.

The ambient atmosphere in the installation location not only affects the lifespan estimation of the mechanisms but it also has a bearing on safety.

4.1 Selection of Installation place

Install the robot in the place where all the following conditions are satisfied.

Table 4.1.1 Check item of installation place

| | | |
|-----|--------------------------|--|
| (1) | <input type="checkbox"/> | Avoid direct sunlight, and the ambient temperature must be in the 0 to 45 degrees Celsius range. |
| (2) | <input type="checkbox"/> | The ambient relative humidity must be less than 80%RH. |
| (3) | <input type="checkbox"/> | The amounts of dust, dirt, oily vapors, water, etc. must be minimal. |
| (4) | <input type="checkbox"/> | There must be no flammable or corrosive liquids or gases present. |
| (5) | <input type="checkbox"/> | The vibration level must be less than 0.5G (4.9m/s ²). |
| (6) | <input type="checkbox"/> | No major sources of electrical noise must be in the vicinity of the robot. |
| (7) | <input type="checkbox"/> | There must be no direct wind of 2 m/sec or more to arc part. |

4.2 Installation of guarding fence and the layout of peripheral equipments

Install a guarding fence as the following, so that no one enters the manipulator's work area during automatic operation.

Install robot controller, operation box, teach pendant and starting box (option) outside the guarding fence.



Install robot controller, welding power supply and the peripheral equipments as operation box outside the guarding fence.

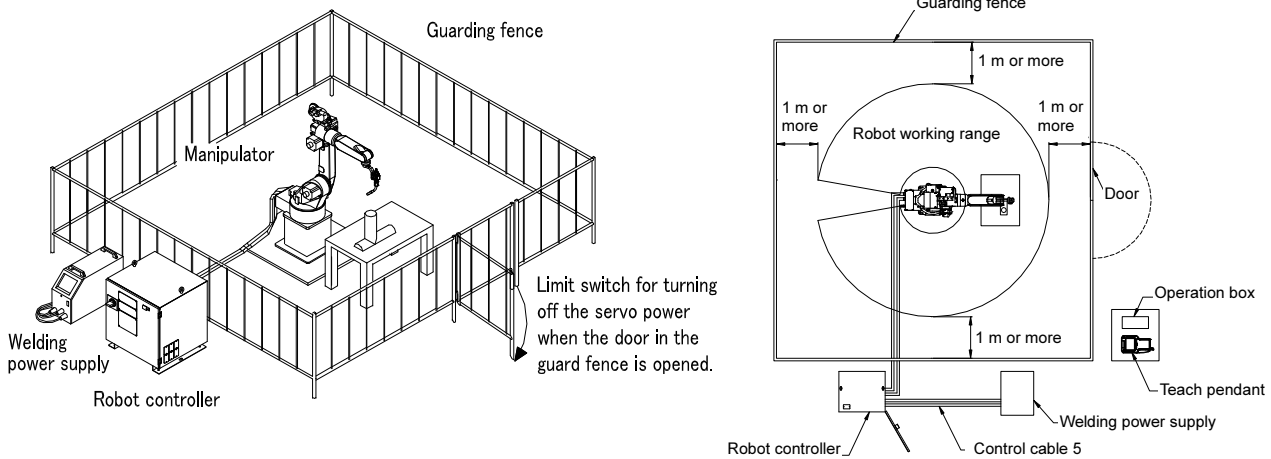


Fig. 4.2.1 Installation of guarding fence

When the installation place of robot controller is selected, note the following points.

- (1) When installing the controller, leave a clearance of at least 100 mm between the controller and the wall behind it in order to ensure proper ventilation inside the robot controller. At the rear side, secure a space of 400 mm at least for external connection cable.
- (2) To install a robot controller and welding power supply, etc. on a place two or more meters in height such as a frame base, a foothold as described in Fig. 4.2.2 is required so that adjustment and maintenance, etc. can be performed.

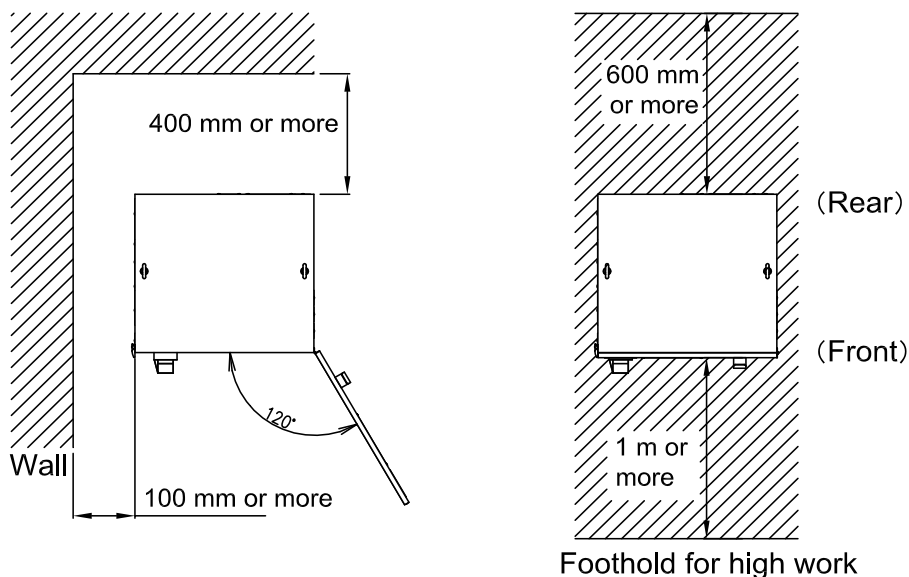


Fig. 4.2.2 Installation of robot controller


Chapter 5 Notes on Safety

For handling a robot, comply with the rules and regulations for industrial robots.

Chapter 6 Warranty

Elapse of 1 year after delivery. (8 hours / day running)

NOTE

| | | | |
|---|--|---|--|
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