



Assembly Instructions & Technical Manual

Model XY-2000 Robotic Arm

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1 Introduction

Welcome to the official assembly manual for the **Model XY-2000**. This guide provides a comprehensive, step-by-step approach to building the model safely and accurately.

Please ensure you read through all instructions, warnings, and notes completely before beginning the assembly process to familiarize yourself with the build sequence.

! Warning: Safety First

Always wear appropriate personal protective equipment (PPE) such as safety goggles when clipping zip ties or handling sharp components. Ensure that the power supply is unplugged before wiring the electronics.

2 Required Tools & Equipment

To complete the assembly, the following tools are required. Ensure your tools are in good working condition to avoid damaging hardware (such as stripping screw heads).

- **Basic Hand Tools:**

- Metric Hex Keys / Allen Wrenches (1.5mm, 2.0mm, 2.5mm, 3.0mm, 4.0mm)
- Phillips Head Screwdriver (#1, #2)
- Small Flathead Screwdriver (for terminal blocks)
- Needle-nose Pliers
- Flush Cutters (for zip ties)

- **Measurement & Testing:**

- Digital Calipers
- Digital Multimeter

- **Consumables:**

- Medium Strength Threadlocker (e.g., Loctite 243 Blue)
- Lithium Grease or PTFE Lubricant
- Zip-ties

3 Bill of Materials (BOM)

Before starting, take inventory of all parts to ensure you have everything required. Open bags sequentially as prompted by the manual to prevent losing small components.

Item #	Part Number	Description	Qty	CheckOut
Structural Components				
1	B-101	Aluminum Base Plate (200x200x5mm)	1	<input type="checkbox"/>
2	L-204	Carbon Fiber Link Arm (150mm length)	2	<input type="checkbox"/>
Motion & Actuators				
3	M-400	Stepper Motor NEMA 17 (1.5A, 40Ncm)	4	<input type="checkbox"/>
4	B-020	Radial Ball Bearing (624ZZ, 4x13x5mm)	6	<input type="checkbox"/>
Fasteners (M3 Series)				
5	S-010	M3x10 Socket Head Cap Screw	45	<input type="checkbox"/>
6	S-016	M3x16 Socket Head Cap Screw	12	<input type="checkbox"/>
7	N-030	M3 Nylon Lock Nut	20	<input type="checkbox"/>
8	W-020	M3 Flat Washer	60	<input type="checkbox"/>

Table 1: Pre-Assembly Inventory Checklist

+ Pro Tip: Hardware Handling

Fasteners are typically supplied with 5% extra quantities. Don't worry if you have a few loose screws left over at the end of the build.

4 Assembly Procedure

i Note: Workspace Preparation

Clear a clean, well-lit, and flat surface. Lay out all parts grouped by their assembly stages to optimize your workflow. Use a magnetic tray for small fasteners.

Step 1: Base Plate Preparation

Parts Needed in this step:

- 1x Aluminum Base Plate (B-101)
- 4x M3x10 Screws (S-010)
- 4x M3 Washers (W-020)

Instructions:

1. Orient the Aluminum Base Plate (B-101) so that the countersunk holes are facing upwards.
2. Clean any manufacturing residue or oils from the plate using isopropyl alcohol and a clean rag.
3. Insert the four M3x10 screws with washers into the corner mounting holes. Do not fully tighten them yet.



Figure 1: Base Plate Orientation

+ Pro Tip: Screw installation

To prevent cross-threading, turn the screw counter-clockwise until you feel a "click", then turn clockwise to tighten.

Step 2: Mounting the Stepper Motor

Parts Needed in this step:

- 1x Stepper Motor NEMA 17 (M-400)
- 4x M3x10 Screws (S-010)

- 4x M3 Washers (W-020)



Figure 2: Motor Alignment and Wire Routing

Instructions:

1. Align the motor shaft with the central cutout on the Base Plate.
2. Ensure the motor's cable connector is facing towards the rear cable channel.
3. Place a washer on each screw and thread them through the plate into the motor mounting face.
4. Tighten the screws gradually in a star (criss-cross) pattern to ensure even pressure.

! Warning: Torque Limit

Do not overtighten the M3 screws securely into the aluminum motor faceplate, as the internal threads are easily stripped. Recommended max torque is 1.5 Nm.

Step 3: Link Arm Assembly

Instructions:

This step connects the first joint.

1. Press-fit the radial ball bearings (B-020) into both ends of the Carbon Fiber Link Arm (L-204). If the fit is tight, ensure you push only on the *outer race* of the bearing to avoid damaging the balls.
2. Slide the assembled Link Arm over the motor shaft hub.
3. Secure using an M3x16 screw (S-016) and a Nylon Lock Nut (N-030).

5 Wiring and Electronics

Once all mechanical assemblies are complete, proceed to wire the control electronics.

i Note: Anti-Static Precautions

Ensure you are grounded (e.g., using an ESD wrist strap) before handling the main control board to avoid electrostatic discharge (ESD) damage to sensitive components.

5.1 Motor Connections

Route all motor wires to the main control board. Use zip-ties every 10cm to secure the cables neatly against the frame. **Ensure cables have enough slack at the joints to allow for the full range of motion.**

Motor	Board Port	Cable Color Coding (Standard)
Base Motor	Axis X / J1	Black, Green, Red, Blue
Shoulder Motor	Axis Y / J2	Black, Green, Red, Blue
Elbow Motor	Axis Z / J3	Black, Green, Red, Blue
Wrist Motor	Axis A / J4	Black, Green, Red, Blue

Table 2: Motor Wiring Map

6 Calibration and Testing

Before putting the model into operation, systematically perform the following checks:

1. **Mechanical bind check:** With power disconnected, slowly move all axes by hand. They should traverse their full range smoothly with consistent resistance.
2. **Power supply verification:** Ensure the power supply is set to the correct local mains voltage (110V or 220V switch) before turning on.
3. **Direction verification:** Connect via the control software and command a +10mm / +10 degree move for each axis individually. Verify that the arm moves in the intended positive direction. If an axis moves backward, power down the board and reverse the motor connector by 180 degrees.

7 Troubleshooting Guide

Symptom	Possible Cause	Corrective Action
Motor stutters, buzzes, but does not rotate	Wiring mismatch or loose connection on one coil phase	Check the 4-pin connector seating. Verify wire pairing via multimeter (continuity check on coils).
Axis binds in certain spots	Misaligned bearings or frame skewed during tightening	Loosen structural screws slightly, actuate the joint to self-align, and retighten carefully.
Excessive noise during operation	Loose pulleys or lack of lubrication on sliding surfaces	Tighten set screws. Apply a small amount of lithium grease to gears/rails.
Board resets when moving multiple axes	Power supply dropping voltage (insufficient current rating)	Check power supply wiring. Verify PSU is rated for at least 150W.

Table 3: Common Issues and Solutions

8 Routine Maintenance Schedule

To ensure the longevity and accuracy of the model, adhere to the following maintenance intervals:

- **After first 10 hours of operation:** Re-check all structural screws (especially those without threadlocker) for tightness. Things will settle during initial run-in.
- **Monthly:** Clean linear rails and gears with a dry cloth. Reapply a light film of PTFE lubricant.
- **Quarterly:** Re-tension drive belts if applicable, and inspect wiring harnesses for any signs of fatigue or rubbing at the joints.