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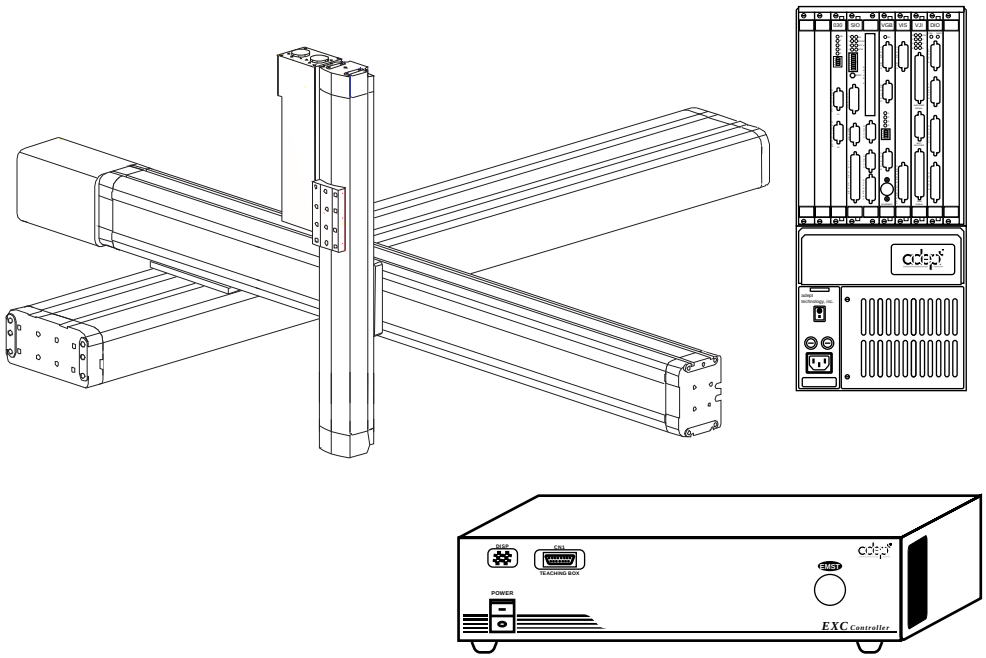
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Instruction Handbook

AdeptModules, Vol. 2

Mechanical Assembly

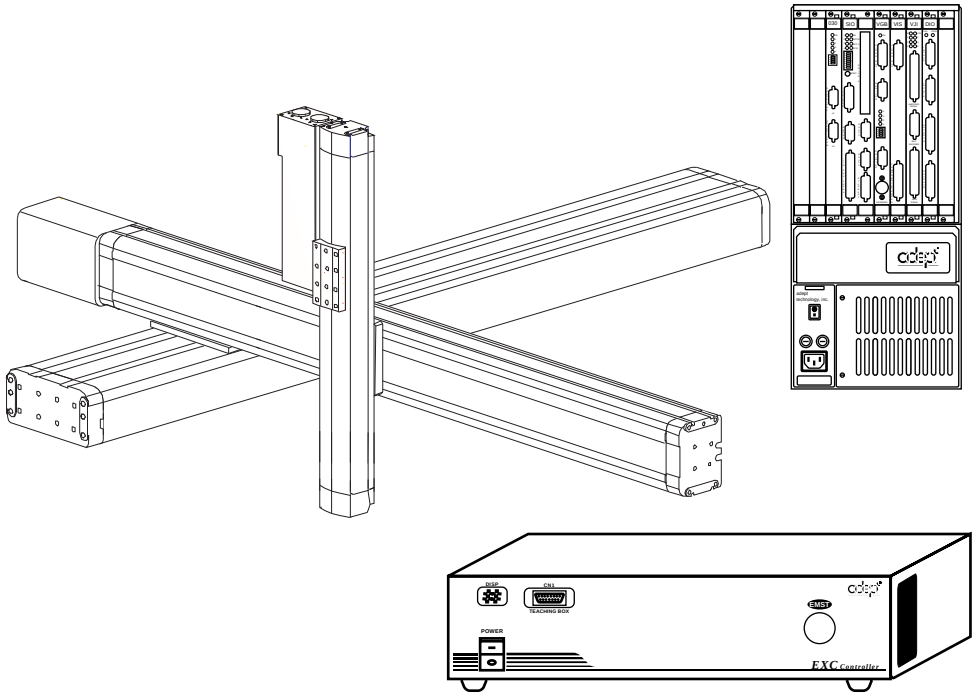


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Instruction Handbook

AdeptModules, Vol. 2

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1.1 Introduction

AdeptModules are a family of linear motion modules which can be used separately or combined into 15 unique 2- to 3-axis configurations. AdeptModules consist of a precision ground, ball-screw drive mechanism, high capacity linear guides, and AC servo motors. AdeptModules also include fully sealed belt covers to protect the module from contaminants.

The AdeptModules are designed to interface with the Adept MV controller and PA-4 power chassis. The interface is done through the Signal Interface Box (SIB). The control and operation of the Modules is programmed and performed through the controller. AdeptModules can also be controlled by NSK's EXC or EXA controller.

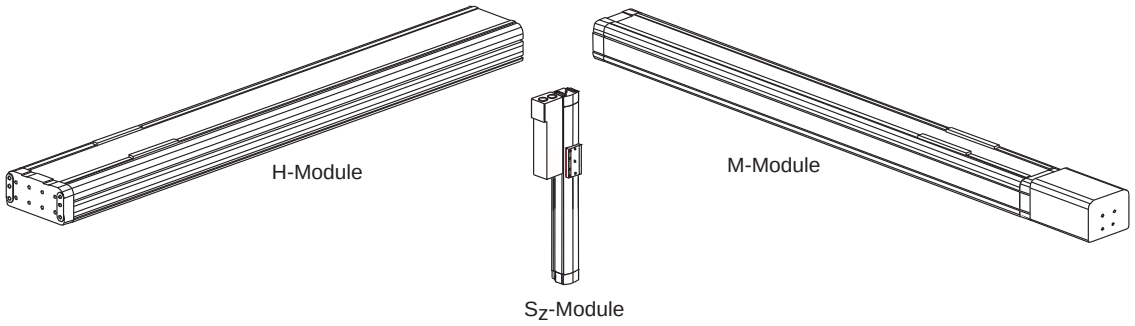


Figure 1-1. AdeptModules

How to use This Manual

This manual is intended to be used with the AdeptModules Volume 1 MV or EXC / EXA Controller Interface manual. This manual is used for the assembly of particular configurations of the AdeptModules system. To operate the AdeptModules from installation of the system to commissioning the system refer to the *AdeptModules , Vol. 1 MV Controller Interface Instruction Handbook* for the type of controller used.

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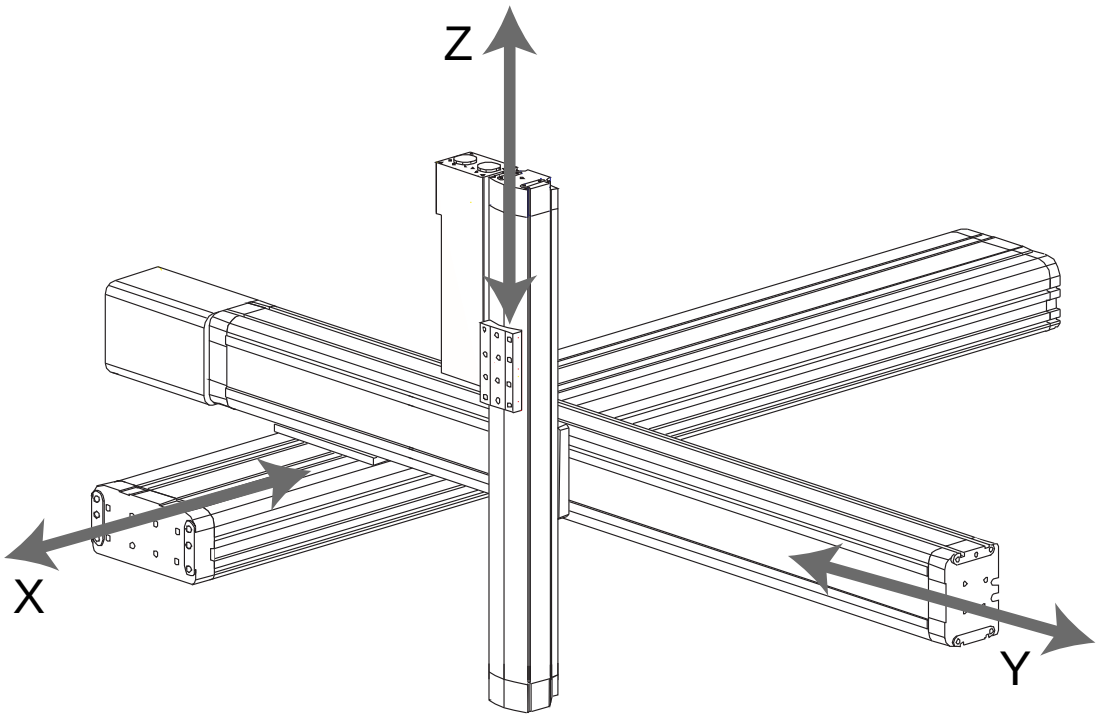


Figure 1-2. AdeptModules Joint Locations

Definition of Manipulating Industrial Robot

A manipulatring robot is automatically controlled, reprogrammable, multi-purpose, manipulative machine with several degrees of freedom (see Figure 1-2) which may be either fixed in a place or mobile for use in industrial automation applications. (ISO 10218:1992(E))

1.2 Notes, Cautions, and Warnings

There are four levels of special notation used in this instruction handbook. In descending order of importance, they are:



WARNING: If the actions indicated in a “WARNING” are not complied with, injury or major equipment damage could result. A Warning statement will typically describe the potential hazard, its possible effect, and the measures that must be taken to reduce the hazard.



WARNING: If in a “WARNING” the actions are indicated with an lightning bolt instead of an exclamation mark, an electrical danger or shock is possible for personnel working with the system.



CAUTION: If the action specified in the “CAUTION” is not complied with, damage to your equipment could result.

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NOTE: A "NOTE" provides supplementary information, emphasizes a point or procedure, or gives a tip for easier operation.

1.3 Precautions and Required Safeguards

This manual must be read by all personnel who install, operate, or maintain Adept systems, or who work within or near the workcell.



WARNING: Adept Technology strictly prohibits installation, commissioning, or operation of an installation with an AdeptModule without adequate safeguards according to the standards EN 775/ISO 10218, sections 5,6; EN 292-1, and EN 60204, section 13, or national equivalent.

AdeptModules Static Forces

AdeptModule systems include computer-controlled mechanisms that are capable of exerting considerable force. Like all robot and motion systems, and most industrial equipment, they must be treated with respect by the user and the operator.

Safety Barriers

Safety barriers must be an integral part of AdeptModules workcell design, installation, Operator training, and operating procedures. Adept systems are computer-controlled, and may activate remote devices under program control at times or along paths not anticipated by personnel. It is critical that safeguards be in place to prevent personnel from entering the workcell whenever equipment power is present.

The AdeptModules are not safe on their own. The AdeptModules System Integrator (or end user) must ensure that adequate safeguards, safety barriers, light curtains, safety gates, safety floor mats, etc., will be installed. The AdeptModules workcell must be designed according to EN 775/ISO 10218, sections 5,6; EN 292-1, 3.71, and EN 60204, section 13, or national equivalent.

The safety distance to the AdeptModules depends, relating to the standard EN 294, on the height of the safety fence. The height and the distance of the safety fence must ensure that nobody can reach the danger zone of the AdeptModules. See EN 294.

Adept controller systems for AdeptModules have various control features which can aid the integrator or user in constructing system safeguards, including Customer Emergency stop circuitry and digital input and output lines. The emergency power-off circuitry is capable of switching external power systems. See Chapter 3 for information on safe and effective use of the AdeptModules.

AdeptModules are capable of moving at high speeds. If a person is struck by an AdeptModules (impacted), serious injury could occur. AdeptModules configuration, joint speed, joint orientation, and attached payload all contribute to the total amount of energy available to cause injury.

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Additional Safety Information

The standards and regulations listed in this handbook contain additional guidelines for AdeptModules system installation, safeguarding, maintenance, testing, start up, and operator training. Table 1-1 below lists sources for the various standards.

Table 1-1. Sources for International Standards and Directives

BSI, British Standards Institute Sales Department Linford Wood Milton Keynes MK14 6LE United Kingdom Phone 0181 996 7000 Fax 0181 996 7001
Beuth Verlag GmbH 10722 Berlin Germany Phone 030 26 01 - 22 60 Fax 030 26 01 - 12 60
American National Standards Institute 11 West 42nd Street, 13th Floor New York, NY 10036 Phone 212-642-4900 Fax 212-398-0023
Document Center, Inc. 1504 Industrial Way, Unit 9 Belmont, CA 94002 Phone 415-591-7600

1.4 Intended Use of the AdeptModules

The installation and usage of Adept products must comply with all safety instructions and warnings in this manual. Installation and usage must also comply with all applicable European, international, or local requirements and safety standards.

The AdeptModules are intended for use in parts assembly and material handling for payloads less than 60kg (132 lbs). Refer to *specific sections in this manual* for configuration and related payloads.



WARNING: For safety reasons it is prohibited to make certain modifications to AdeptModules. See Section 1.5.

The Adept MV controller, Adept PA-4 power chassis and the EXC/EXA controllers are intended for use as component subassemblies of a complete industrial automation system. The controllers and power chassis subassemblies must be installed inside a suitable enclosure. The controllers and power chassis subassemblies must not come into contact with liquids.

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Adept equipment is not intended for use in any of the following situations:

- In hazardous (explosive) atmospheres.
- In mobile, portable, marine, or aircraft systems.
- In life-support systems.
- In residential installations.
- In situations where the Adept equipment will be subject to extremes of heat or humidity. See specifications for allowable temperature and humidity ranges.



WARNING:
The given instructions about operation, installation, and maintenance in this Instruction Handbook must be strictly observed.

Non-intended use of an AdeptModules can:

- cause injury to personnel.
- damage the AdeptModules or other equipment.
- reduce the system reliability and the performance of the system.
- All persons that install, commission, operate, or maintain the AdeptModules must:
- have the necessary qualifications.
- read and follow exactly the instructions in this Instruction Handbook.

If there is any doubt concerning the application, ask Adept to determine if it is an intended use or not.

1.5 AdeptModules Modifications

It is sometimes necessary to modify the AdeptModules in order to successfully integrate it into a workcell. Unfortunately, many seemingly simple modifications can either cause an AdeptModules failure or reduce the AdeptModules performance, reliability, or lifetime. The following information is provided as a guideline to modifications.

Acceptable Modifications

In general, the following AdeptModules modifications will not cause problems but may affect AdeptModules performance:

- Attaching tooling, utility boxes, solenoid packs, vacuum pumps, screwdrivers, cameras, lighting, etc., to the AdeptModule mounting plates, combining brackets, or cable brackets.
- Attaching hoses, pneumatic lines, or cables to the AdeptModules. These should be designed so they do not restrict joint motion or cause AdeptModules motion errors.

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Unacceptable Modifications

If not done properly, the modifications listed below will damage the AdeptModules, reduce system safety and reliability, or shorten the life of the AdeptModules.



CAUTION: Making any of the modifications outlined below will void the warranty of any components that Adept determines were damaged due to the modification. You must contact Adept Customer Service if you are considering any of the following modifications.

- Modifying any of the AdeptModules harnesses or Modules-to-controller cables.
- Modifying any AdeptModule covers or drive system components.
- Modifying, including drilling or cutting, any AdeptModules casting or extrusions.
- Routing additional hoses, air lines, or wires through the modules or modules cable tracks.

1.6 Endangerment Through Additional Equipment

Additional equipment—for instance grippers, conveyor belts, etc.—may not be used if it would reduce the safeguarding of the workcell.

All Emergency Stop Switches must be always accessible.

In other countries, Adept strongly recommends a similar level of safety be obtained, in addition to complying with the applicable local and national regulations.

1.7 Working Areas

AdeptModules have both a Manual and an Automatic operating mode. While AdeptModules is in Automatic Mode, no personnel are allowed to stay in the workcell.

Operators with additional safety equipment (see section 1.10 on page 29) are allowed to work in the workcell when AdeptModules is in manual mode. For safety reasons the operator should, whenever possible, stay outside of the working envelope of the AdeptModules to prevent injury. The maximum speed and power of the AdeptModules is reduced, but it could still cause injury to the operator.

Before performing maintenance in the working envelope of the AdeptModules, personel must switch off High Power and disconnect the power to the PA4 power chassis. After these precautions, a skilled person is allowed to maintain the AdeptModules. See section 1.8 on page 29 for the specifications of the personnel.



WARNING:
Electrical Hazard!
Impact Hazard!
Never remove any safeguarding, and never make changes in the system that will decommission a safeguard.

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1.8 Qualification of Personnel

This manual assumes that personnel have attended proper training courses and have a working knowledge of the system. The user must provide the necessary additional training for all personnel who will be working with the system.

As noted in this handbook, certain procedures should be performed only by **skilled** or **instructed** persons. For a description of the level of qualification Adept uses the standard terms:

- **Skilled persons** have technical knowledge or sufficient experience to enable them to avoid the dangers which electricity may create (engineers and technicians).
- **Instructed persons** are adequately advised or supervised by skilled persons to enable them to avoid the dangers which electricity may create (operating and maintenance staff).

All personnel must observe sound safety practices during the installation, operation, and testing of all electrically powered equipment. To avoid injury or damage to equipment, always remove power by disconnecting the AC power cord from the source before attempting any repair or upgrade activity.



WARNING: The user is obligated to get confirmation from every entrusted person before they start working with the AdeptModules about the following subjects:
1) The person has received the Instruction Handbook, has read it, and has understood it.
2) The person will work in the described manner.

1.9 Transport

Always use adequate equipment to transport and lift Adept devices. See Chapter 3 for more information on transporting, lifting, and installing.



WARNING: Do not stay under the AdeptModule while it is transported.

1.10 Safety Equipment for Operators

Adept advises operators to wear extra safety equipment in the workcell. For safety reasons the operators must wear

- safety glasses
- protective headgear
- and safety shoes

Install warning signs around the workcell to make sure anyone working around the AdeptModules system knows they must wear safety equipment.

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1.11 Protection Against Unauthorized Operation

The system must be protected against unauthorized use. Restrict access to the keyboard and the Manual Control Pendant by locking them in a cabinet or use another adequate method to prevent access to them.

1.12 Operating Modes of AdeptModules

AdeptModules can be controlled via an Adept MV Controller or an EXC/EXA controller.

Adept MV Controller

Automatic Mode

AdeptModules systems are computer-controlled, and the program that is currently running the AdeptModules may cause it to move at times or along paths you may not anticipate. When the key switch for the operating mode is in the AUTO position and the HIGH POWER light or the PROGRAM RUNNING light on the external Front Panel (VFP) are illuminated, do not enter the workcell because the AdeptModules or motion device might move unexpectedly. (The LAMP TEST button on the VFP allows these lights to be periodically checked.)



WARNING: During Automatic Mode operations no person is allowed to stay in the guarded space of the AdeptModules, because serious injury can occur if a person is struck by the AdeptModules.

Manual Mode

AdeptModules can also be controlled manually when the operating mode key switch is in the MANUAL position and the HIGH POWER light on the VFP is illuminated. When Manual mode is selected, motion can be only initiated from the Manual Control Pendant (MCP). Per EN 775/ISO 10218, the *maximum speed of the AdeptModules is limited to less than 250 mm per second (10 ips) in Manual mode.* In this mode, work that requires close approach to the installation or AdeptModules can be performed, such as teaching points, program verification, or troubleshooting operations.

NOTE: The MCP has two operating modes. In MAN (Manual) mode the MCP can initiate an AdeptModules motion. In COMP (Automatic) mode the MCP works like a terminal.

EXC/EXA Controller

External Operations

AdeptModules systems are computer-controlled, and the program that is currently running the AdeptModules may cause it to move at times or along paths you may not anticipate. This mode of operation is automatically established after the main power is enabled. When in External Operation the AdeptModules are controlled by external I/O signals. Do not enter the workcell because the AdeptModules or motion device might move unexpectedly.

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WARNING: During Automatic Mode operations no person is allowed to stay in the guarded space of the AdeptModules, because serious injury can occur if a person is struck by the AdeptModules.

Teach Box Operation

The AdeptModules can also be controlled manually by the teach box. Three operations can be performed with the teach box: Home return, Jogging, and Programming. In this mode, work that requires close approach to the installation or AdeptModules can be performed, such as teaching points, program verification, or troubleshooting operation.

1.13 Safety Aspects While Performing Maintenance

Only skilled persons with the necessary knowledge about the safety and operating equipment are allowed to maintain the AdeptModules, controller, and power chassis.



WARNING: During maintenance and repair, the power of the Adept PA-4 power chassis and the Adept MV controller must be turned off. Unauthorized third parties must be prevented from turning on power through the use of fail-safe lockout measures. (Turn off the circuit breakers, lock the cabinet, and remove the key!)

1.14 What to Do in an Emergency Situation

Press any Emergency-Stop button (a red push-button on a yellow field) and then follow the internal procedures of your company or organization for an emergency situation. If a fire occurs, use CO_2 to extinguish the fire.

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2.1 Introduction

AdeptModules are a family of linear motion actuators which can be used separately or combined into 15 unique 2- and 3-axis configurations. AdeptModules consist of a precision-ground ball-screw drive mechanism, high-capacity linear guides, and AC servo motors. AdeptModules also include fully sealed belt covers to protect the module from contaminants.

Module Types

AdeptModules are offered in the four module types described in the following sections.

H-Module

The H-module is the largest module with the highest payload and moment capacity. The H-module is offered in standard stroke lengths between 300 mm (12 inches) and 1000 mm (40 inches) and special-order stroke lengths from 1200 mm (47 inches) to 2000 mm (80 inches).

The H-module consists of a 20 mm pitch ball screw, two 25 mm linear guides, and a 300 watt motor without a holding brake.

The H-module is 180 mm (7 inches) wide and 90 mm (3.5 inches) in height. The overall length of the H-module depends on the stroke length. The standard H-modules are supplied with direct-mount motors. Extended stroke H-modules are supplied with side-mount motors.

M-Module

The M-Module is the midsize module with the midrange payload and moment capacity. The M-Module is offered in standard stroke lengths between 250 mm (10 inches) and 950 mm (37 inches) and special-order stroke lengths from 1,150 mm (inches) to 1,550 mm (inches).

The M-module consists of a 20 mm pitch ball screw, a single 50 mm linear guide, and the same 300 watt motor without a holding brake.

The M-module is 116 mm (4.6 inches) wide and 85 mm (3.4 inches) in height. The overall length of the M-module depends on the stroke length. The standard M-modules are supplied with direct-mount motors. Extended stroke M-modules are supplied with side-mount motors.

S-Module

The S-Module is the smallest profile module intended for horizontal applications. The S-Module is offered in standard stroke lengths between 130 mm (5 inches) and 530 mm (21 inches) and special-order stroke lengths of 630 mm (24.8 inches).

The S-module consists of a 10 mm pitch ball screw for 130 mm and 230 mm stroke lengths and a 20 mm pitch ball screw for stroke lengths from 330 mm to 630 mm. The S-module has a single 25 mm linear guide and a 100 watt motor without a holding brake.

The S-module is 66 mm (2.6 inches) wide and 66 mm (2.6 inches) in height. The overall length of the S-module depends on the stroke length. The standard S-modules are supplied with right side-mount motors.

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Sz-Module

The Sz-module has the same profile and design as the S-module, but has a left side-mount motor and a 100 watt motor with a holding brake for use in vertical applications.

Gantry Support Modules

Gantry Support Modules consist of a single 25 mm linear guide in a cross-section similar to the S/Sz-module. The gantry support is intended to be used with a G-1 or P-1 configuration and therefore is available in stroke lengths to match the stroke length of an H-Module. The gantry support module is provided with a bracket that mounts to the end of the M-module and mates with a bracket affixed to the linear guide on the gantry support bracket.

Class 10 Cleanroom Modules

All standard modules are offered in a Class 10 compatible cleanroom version. The cleanroom modules have three differences from standard modules:

- cleanroom modules are assembled with a different belt material to greatly reduce the generation of particles.
- cleanroom modules contain a special cleanroom grease.
- cleanroom modules have two air fittings to connect a vacuum supply for removing particles from the internal cavity of the module.

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2.2 Modules Specifications

Table 2-1. Standard and Cleanroom Modules

Module Type	Part Number (9040x-)[a]	Stroke (mm)	Max. Speed (mm/sec)	Repeatability (± mm/±in)	Ball Screw Pitch (mm)	Max. Payload (kg/lb)	Motor Mount[b]	Rated Thrust Force (n/lb)	Moment Capacity (n-m/lb-ft)[c]		
									Roll	Pitch	Yaw
H-module	10030	300	1200	0.01/0.0004	20	60/132	Direct	300/67	600/442	400/295	350/258
	10040	400									
	10050	500									
	10060	600									
	10080	800									
	10100	1000									
	17120	1200									
M-Module	20025	250	1200	0.01/0.0004	20	60/132	Direct	300/67	70/52	120/89	120/89
	20035	350									
	20045	450									
	20055	550									
	20075	750									
	20095	950									
S-Module (horizontal)	30013	130	600	0.01/0.0004	10	20/44	Right	240/54	27/20	10/7.4	10/7.4
	30023	230									
	30033	330	1200	0.01/0.0004	20	20/44	Right	120/27	27/20	10/7.4	10/7.4
	30043	430									
	30053	530									
Sz-Module (vertical)	40013	130	600	0.01/0.0004	10	15/33	Left	240/54	27/20	10/7.4	10/7.4
	40023	230									

[a] Where x = 0 for Standard modules and x = 1 for Cleanroom modules.
[b] See Figure 2-1.
[c] See Figure 2-2.

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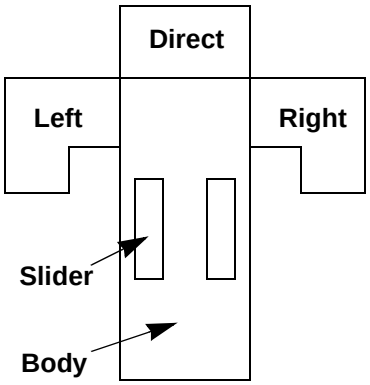


Figure 2-1. Motor Mount

Table 2-2. Extended Stroke Modules

Module Type	Part Number (90400-)	Stroke (mm)	Extended Strokes		
			Speed (mm/sec)	Ball Screw Pitch (mm)	Motor Mount[a]
H-Module	11120	1200	1200	40[b]	Right
	11140	1400	1080		
	11160	1600	840		
	11180	1800	680		
	11200	2000	560		
M-Module	21115	1150	1200	40[b]	Right
	21135	1350	1080		
	21155	1550	840		
S-Module	31063	630	1200	20	Right
Sz-Module	41033	330	600	10	Left (Standard)
	41043	430			
	41053	530			
	41063	630			

[a] See Figure 2-1.
[b] 50% reduction due to timing belt.

Module Moment Capacity

Figure 2-2 shows the rolling, pitching, and yawing moments of a module. Rolling, pitching and yawing moment capacities are specified for each module in Table 2-1.

The rolling moment capacity is the torque capacity of the module around the x-axis. The x-axis runs through the centerline of the ball screw.

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The pitching moment capacity is the torque capacity of the module around the y-axis of the module. The y-axis is the axis perpendicular to the x-axis and in the same plane as the module top surface.

The yawing moment capacity is the torque capacity of the module around the z-axis of the module. The z-axis is the axis perpendicular to both the x-axis and y-axis and perpendicular to the top surface of the module.

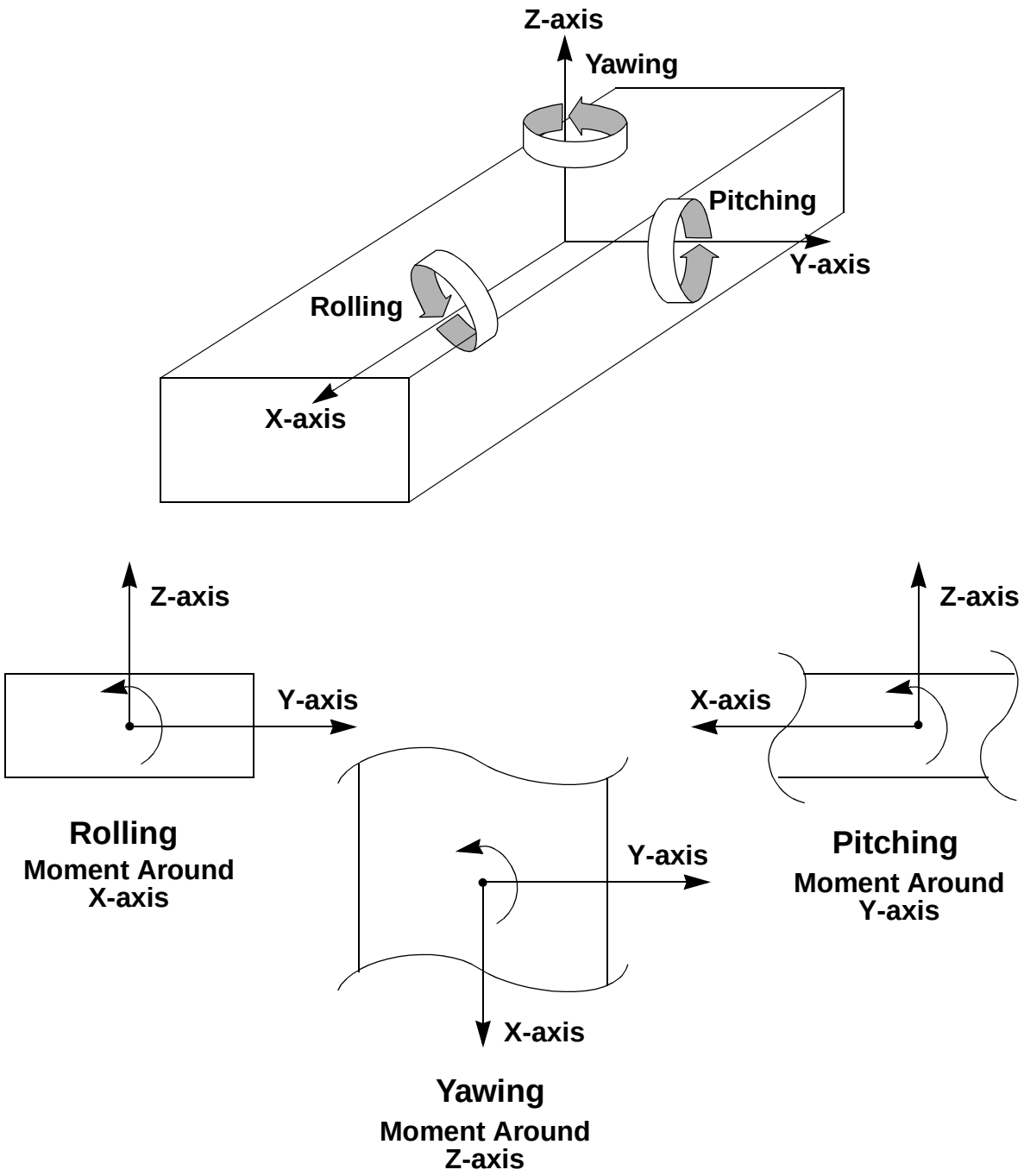


Figure 2-2. Yaw, Pitch, and Roll Examples

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2.3 AdeptModule Life and Yawing Moment Calculations

Some calculations can be done to estimate the life of an AdeptModule under particular loading conditions. The two primary factors that affect the module life are the applied payloads and moments (yaw, pitch, and roll) about the flange.

The following table lists the maximum payload and moment capacities of each module type. These values will be used in the life calculations.

Table 2-3. Maximum Payload and Moment Capacities

Module Type	Maximum Payload Capacity(kg)	Maximum Moment Capacity		
		Roll (N-m)	Pitch (N-m)	Yaw (N-m)
H-Module	60	600	400	350
M-Module	40	70	120	120
S-Module	20	27	10	10
Sz-Module	15	27	10	10

Life Calculations

There are two formulas for estimating the module life; one is based upon the payload, and the other upon the applied moments:

$$lifePayload(km) = 5000(km) \times \left(\frac{PayloadCapacity}{MaxAppliedPayload}\right)^3$$

$$lifeMoment(km) = 5000(km) \times \left(\frac{MomentCapacity}{MaxAppliedMoment}\right)^3$$

NOTE: Calculating the maximum applied moment consists of three separate calculations (Roll, Pitch, and Yaw).

For the above calculations, take the minimum value as the final solution of the estimated module life.

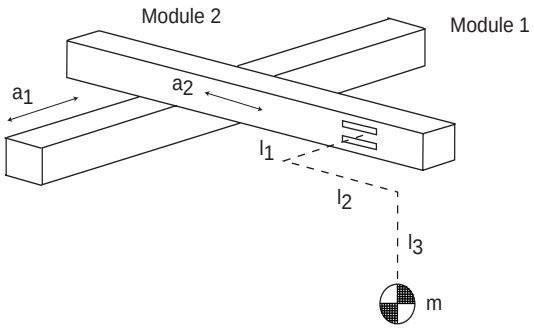
Moment Calculations

When configuring AdeptModule systems, it is very important that the moment capacities of the modules are not exceeded. Exceeding the moment capacity will result in a premature failure of the linear guide within the module. In each case, the mounting of the module, the mass of the payload, and the accelerations of the modules determine the total applied moments.

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The following equations include the static and dynamic loading conditions for each module configuration. These equations assume "worst case" loading conditions. Some of the mathematical terms have been approximated.

G-Style Configuration



L_2 = length of Module 2 (m)
w_2 = width of Module 2 (m)
M_2 = mass of Module 2 (kg)
m = mass of applied payload (kg)
a_1 = max acceleration of Module 1 (m/s^2)
a_2 = max acceleration of Module 2 (m/s^2)
g = gravitational acceleration ($9.8m/s^2$)
l_1,l_2, l_3 = distances from flange to center of mass of applied payload (m)

Module 2

$$(RollingMoment)_2 = m(gl_1 + a1l_3)$$

$$(YawingMoment)_2 = m(gl_2 + a_2l_3)$$

$$(PitchingMoment)_2 = m(a_2l_1 + a_1l_2)$$

Module 1

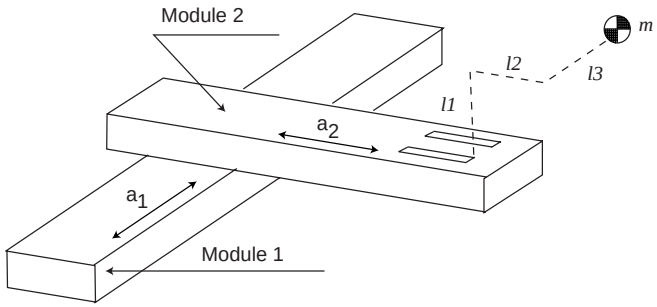
$$(RollingMoment)_1 = (YawingMoment)_2 + M_2g\frac{L_2}{4}$$

$$(YawingMoment)_1 = (PitchingMoment)_2 + M_2a_1\frac{L_2}{4}$$

$$(PitchingMoment)_1 = (RollingMoment)_2 + m_2a_1\frac{w_2}{2}$$

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D-Style Configuration



L_2 = total length of Module 2 (m)
w_2 = width of Module 2 (m)
M_2 = mass of Module 2 (kg)
m = mass of applied payload (kg)
$a1$ = max acceleration of Module 1 (m/s^2)
a_2 = max acceleration of Module 2 (m/s^2)
g = gravitational acceleration (9.8 m/s^2)
l_1, l_2, l_3 = distances from flange to center of mass of applied payload (m)

Module 2

$$(RollingMoment)_2 = m(gl_3 + a_1 l_1)$$

$$(YawingMoment)_2 = ma_2 l_3$$

$$(PitchingMoment)_2 = m(gl_2 + a_2 l_1)$$

Module 1

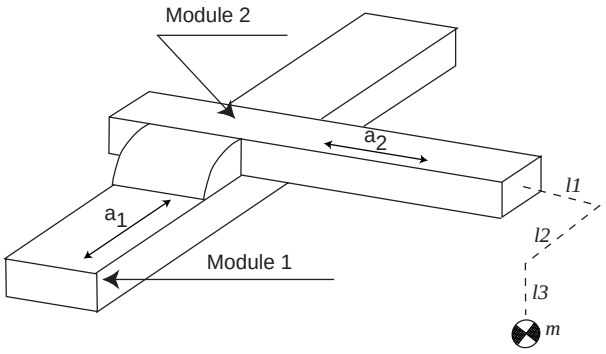
$$(RollingMoment)_1 = (PitchingMoment)_2 + M_2 g\frac{L_2}{4}$$

$$(YawingMoment)_1 = (YawingMoment)_2 + M_2 a_1 \frac{L_2}{4}$$

$$(PitchingMoment)_1 = (RollingMoment)_2 + M_2 a_1 \frac{w_2}{2}$$

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X-Style Configuration



L_2 = *total length of Module 2 (m)*
h_2 = *height of Module 2 (m)*
w_2 = *width of Module 2 (m)*
M_2 = *mass of Module 2 (kg)*
m = *mass of applied payload (kg)*
a_1 = *max acceleration of Module 1 (m/s_2)*
a_2 = *max acceleration of Module 2 (m/s_2)*
g = *gravitational acceleration (9.8 m/s_2)*
l_1, l_2, l_3, = *distances from flange to center of mass at applied payload (m)*

Module 2

$$(RollingMoment)_2 = m(gl_1 + a_1 l_3) + M_2 g\frac{h_2}{2}$$

$$(YawingMoment)_2 = m(g(l_1 + L_2) + a_2 l_3) + M_2 g\frac{L_2}{4}$$

$$(PitchingMoment)_2 = m(a_1(l_1 + L_2) + a_2 l_2) + M_2 a_1\frac{L_2}{4}$$

Module 1

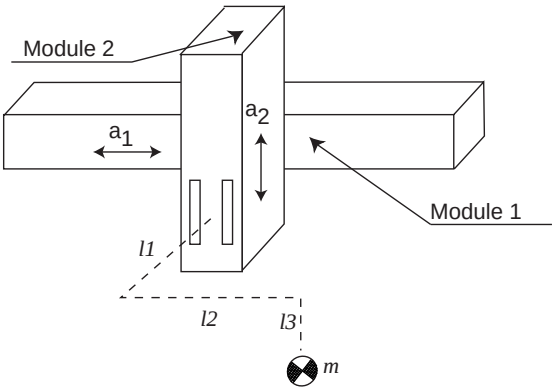
$$(RollingMoment)_1 = (YawingMoment)_2$$

$$(YawingMoment)_1 = (PitchingMoment)_2$$

$$(PitchingMoment)_1 = (RollingMoment)_2 + M_2 a_1\frac{w_2}{2}$$

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K-Style Configuration



H_2 = height of Module 2 (m)
L_1 = length of Module 1 (m)
L_2 = length of Module 2 (m)
M_2 = mass of Module 2 (kg)
m = mass of payload (kg)
a_1 = max acceleration of Module 1 (m/s_2)
a_2 = max acceleration of Module 2 (m/s_2)
g = gravitational acceleration (9.8 m/s_2)
l_1, l_2, l_3 = distances from flange to center of mass of applied payload (m)

Module 2

$$(RollingMoment)_2 = ma_1l_1$$

$$(YawingMoment)_2 = m(gl_2 + a_2l_2 + a_1l_3)$$

$$(PitchingMoment)_2 = ml_1(g + a_2)$$

Module 1

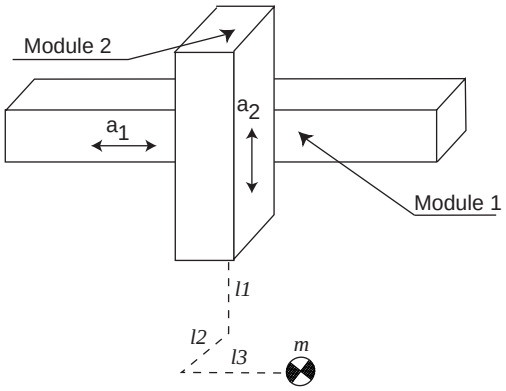
$$(RollingMoment)_1 = (PitchingMoment)_2 + M_2g\frac{H_2}{2}$$

$$(YawingMoment)_1 = (YawingMoment)_2 + M_2a_1\frac{L_2}{4}$$

$$(PitchingMoment)_1 = (RollingMoment)_2 + M_2a_1\frac{H_2}{2}$$

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Z-Style Configuration



L_2 = *length of Module 2 (m)*
M_2 = *mass of Module 2 (kg)*
H_2 = *height of Module 2 (m)*
m = *mass of applied payload (kg)*
a_1 = *max acceleration of Module 1 (m/s_2)*
a_2 = *max acceleration of Module 2 (m/s_2)*
g = *gravitational acceleration (9.8 m/s_2)*
l_1, l_2, l_3 = *distances from flange to center of mass of applied payload (m)*

Module 2

$$(RollingMoment)_2 = ma_1l_2 + M_2a_1\frac{H_2}{2}$$

$$(YawingMoment)_2 = ml_3(g + a_2) + a_1\left(M_2\frac{L_2}{4} + m(l_1 + L_2)\right)$$

$$(PitchingMoment)_2 = \left(ml_2 + M_2\frac{H_2}{2}\right)(g + a_2)$$

Module 1

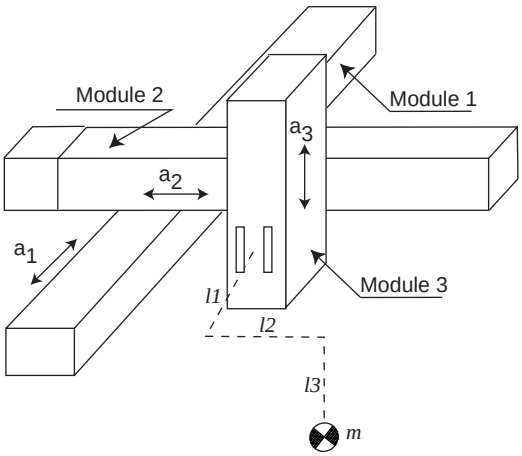
$$(RollingMoment)_1 = (PitchingMoment)_2$$

$$(YawingMoment)_1 = (YawingMoment)_2$$

$$(PitchingMoment)_1 = (RollingMoment)_2$$

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P-Style Configuration



L_2 = *length of Module 2 (m)*
M_2 = *mass of Module 2 (kg)*
L_3 = *length of Module 3 (m)*
M_3 = *mass of Module 3 (kg)*
H_3 = *height of Module 3 (m)*
w_2 = *width of Module 2 (m)*
m = *mass of applied payload (kg)*
a_1 = *max acceleration of Module 1 (m/s_2)*
a_2 = *max acceleration of Module 2 (m/s_2)*
a_3 = *max acceleration of Module 3 (m/s_2)*
g = *gravitational acceleration (9.8 m/s_2)*
l_1, l_2, l_3 = *distances from flange to center of mass of applied payload (m)*

Module 3

$$(RollingMoment)_3 = m(a_2 l_1 + a_1 l_2)$$

$$(YawingMoment)_3 = m[a_2 l_3 + l_2(g + a_3)]$$

$$(PitchingMoment)_3 = m[a_1 l_3 + l_2(g + a_3)]$$

Module 2

$$(RollingMoment)_2 = (PitchingMoment)_3 + M_3 a_1 \frac{L_3}{4}$$

$$(PitchingMoment)_2 = (RollingMoment)_3 + M_3\left(a_2 \frac{H_3}{2} + a_1 L_2\right)$$

$$(YawingMoment)_2 = (YawingMoment)_3 + M_3 a_2 \frac{L_3}{4}$$

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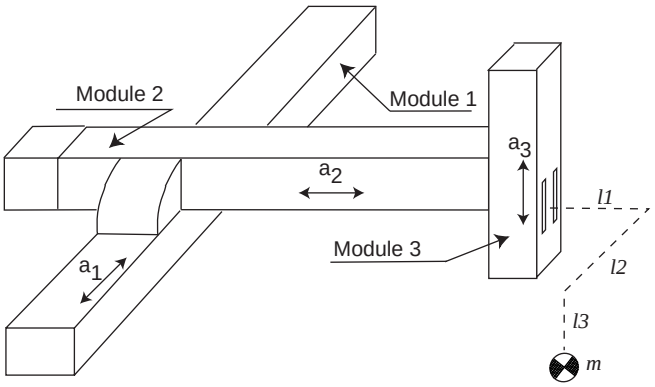
Module 1

$$(RollingMoment)_1 = (YawingMoment)_2 + \left(M_2\frac{L_2}{4} + M_3L_2\right)g$$

$$(YawingMoment)_1 = (PitchingMoment)_2 + \left(M_2\frac{L_2}{4} + M_3L_2\right)a_1$$

$$(PitchingMoment)_1 = (RollingMoment)_2 + \left(M_2\frac{w_2}{2} + M_3\frac{w_2}{2}\right)a_1$$

J-Style Configuration



L_2 = length of Module 2 (m)
M_2 = mass of Module 2 (kg)
w_2 = width of Module 2 (m)
L_3 = length of Module 3 (m)
M_3 = mass of Module 3 (kg)
m = mass of applied payload (kg)
a_1 = max acceleration of Module 1 (m/s_2)
a_2 = max acceleration of Module 2 (m/s_2)
a_3 = max acceleration of Module 3 (m/s_2)
g = gravitational acceleration (9.8 m/s_2)
l_1, l_2, l_3 = distances from flange to center of mass of applied payload (m)

Module 3

$$(RollingMoment)_3 = m(a_2l_2 + a_1l_1)$$

$$(YawingMoment)_3 = m[a_1l_3 + l_2(g + a_3)]$$

$$(PitchingMoment)_3 = m[a_2l_3 + l_1(g + a_3)]$$

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Module 2

$$(RollingMoment)_2 = (YawingMoment)_3$$

$$(PitchingMoment)_2 = (RollingMoment)_3 + \left(M2\frac{L_2}{4} + M_3L_2\right)a_1$$

$$(YawingMoment)_2 = (PitchingMoment)_3 + \left(M2\frac{L_2}{4} + M_3L_2\right)g$$

Module 1

$$(RollingMoment)_1 = (YawingMoment)_2 + (M_2 + M_3)a_2\frac{w_2}{2}$$

$$(YawingMoment)_1 = (PitchingMoment)_2$$

$$(PitchingMoment)_1 = (RollingMoment)_2$$

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3.1 Introduction

This chapter provides an overview of the AdeptModules mechanical assembly process.

All AdeptModules systems start with a main module unit. The main unit is considered axis one and is generally referred to as the X-axis. Installation of the main unit for all configurations is covered in this chapter. Begin your installation by following the procedures in this chapter regardless of the total number of axes in your system.

If your system includes a second axis, see “Mechanical Assembly, Adding Axis Two” starting on page 59 for details on adding the second axis. If your system includes a third or fourth axis, see “Mechanical Installation, Adding Axis Three” starting on page 141 for details on adding the third and fourth axes.

There are many possible combinations of AdeptModules. In most cases the assembly instructions will apply to a range of modules. The applicable range for a given assembly process is provided in tables that look similar to:

X-Axis Main Unit	Y-Axis Main Unit	Combining Bracket
90400-10**0	90400-200*5	90400-05002

This table indicates that any X-axis unit with a serial number between 90400-10000 and 90400-10990 may be used in the installation, any Y-axis unit with a serial number between 90400-20005 and 90400-20095 may be used, and combining bracket 90400-05002 must be used.Transporting AdeptModules

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3.2 Transporting a Single Axis

The main unit must be transported using a sling as shown in (Figure 3-1).

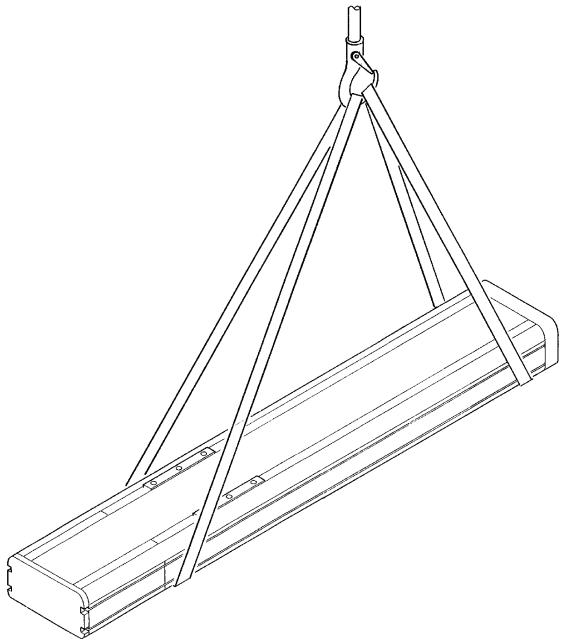


Figure 3-1. Transporting Modules



WARNING: Do not stand under a module during transportation. Personal injury can occur.



WARNING: The robot module is a precision machine. Be careful to avoid impacts or excessive jarring of the module during handling.

3.3 Warranty Requirements

The following precautions must be observed or the AdeptModules warranty may be void. Read these precautions before beginning installation and observe them during installation and operation.

NOTE: Install the main unit on a smooth, finished surface (recommended flatness: 0.1 mm or less)

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1. When installing the main unit on the base, or installing equipment on the main unit or slider, the mounting bolts must be mounted to the screw-in depths specified in Table 3-1 through Table 3-3.
2. Do not disassemble any part other than those mentioned in the “Maintenance” section.
3. The robot module connectors are similar for all modules. When connecting modules to the controller, check for proper connection before applying power. Improper connection may result in motor damage.
4. Do not attempt to restrict the motion of the main unit with an external restraint. When pushing or pulling the work, the moment applied to the main unit must be equal to, or less than, the transportable moment. See “Chapter 8” for details.
5. The main unit is protected against contamination by sealing belts. However, the unit should be kept away from water or oil splash.
6. Use the main unit at an ambient temperature between 0° and 40° C (non-condensing). The motors within the main unit, in particular, release heat. Consequently, no heat source should be placed near the unit.
7. The drive pin of the combining bracket and the pin hole on the main unit are high-precision mating surfaces. Thus, you may experience some resistance in positioning the pin in the hole. In these cases, press the bracket and main unit together firmly, using care to avoid damaging the hole in the process.

3.4 Mounting the Main Unit to a Base

All AdeptModules installations, regardless of the number of axes, begin by mounting the main unit (axis one) to the base.

Adept recommends the use of socket head cap screws for installation, as specified in Table 3-1. Other specifications are listed in individual tables throughout the manual.

Table 3-1. Mounting Screw Recommendations

Bolt Diameter	**M8**	M6	M5
Pitch	1.25 mm	1.0 mm	0.8 mm

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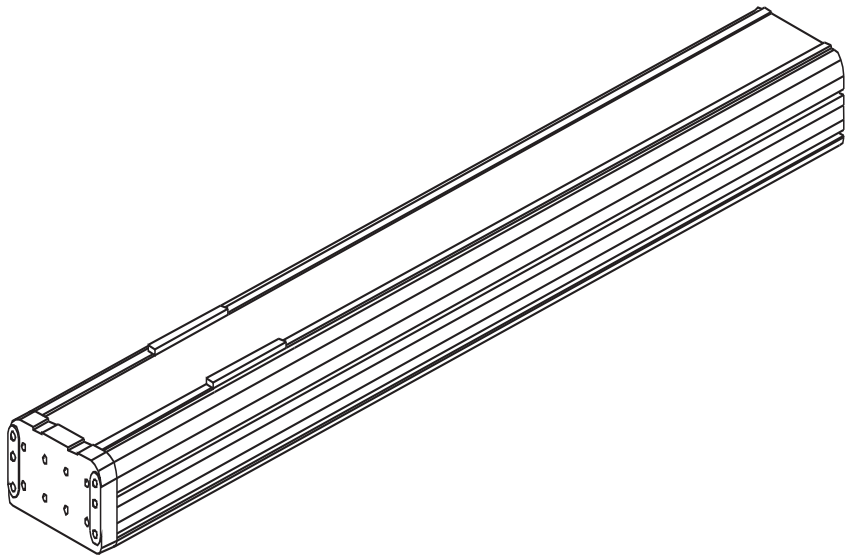


Figure 3-2. Typical Single-Axis Module

The main unit may be attached in two ways: bolting the main unit directly to the work surface using the tap holes on the bottom of the main unit or attaching a bracket(s) to the bottom of the main unit and then attaching the bracket to the work surface.

> **NOTE:** The mounting surface should be a finished surface with a flatness of approximately 0.1 mm and be free from harmful projections. When the bolt fixing portions are lifted, use shims to adjust the flatness.

See Chapter 8, “Technical Specifications” for dimensions on specific AdeptModule types.

Direct Attachment Using the Tap Holes on the Bottom of the Main Unit

1. In Chapter 8 locate the dimension drawing for the module you are attaching.
2. Using the layout and screw size information on the dimension drawing, mark and drill twelve holes through the mounting base.
3. Select the correct size bolts based on the specifications in Table 3-1 and Table 3-2 and attach the main unit to the base as shown in Figure 3-3.

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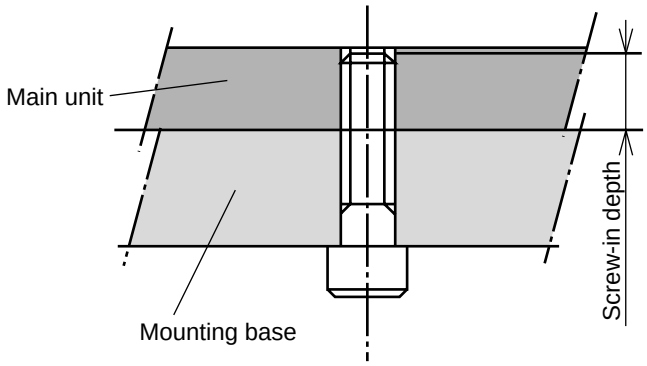


Figure 3-3. Attaching Main Unit Directly to the Base

NOTE: The mounting bolts should meet the specifications given in Table 3-1 and Table 3-2.

Table 3-2. Mounting Screw Specifications

	H-Module	M-Module	S-Module
Bolt Diameter	M8	M6	M5
Screw-In Depth	12-16 mm	9-12 mm	7-9 mm
Tightening Torque	33.3 N•m 340 kgf•cm 294.7 in•lb	14.7 N•m 150 kgf•cm 130.1 in•lb	5.9 N•m 60 kgf•cm 52.2 in•lb

Attaching Using the Optional Mounting Brackets

1. In Chapter 8 locate the dimension drawings for the module and the mounting bracket that you are installing.
2. Using the layout and screw size information on the dimension drawing, mark and drill four holes through the mounting base for each bracket used. Two brackets are recommended for 600mm or smaller units and three brackets are recommended for larger units.
3. Attach the mounting brackets to the main unit with the bolts supplied in the kit (the required screw sizes are listed in Table 3-3).
4. Bolt the mounting brackets to the work surface using the screw specifications shown in Table 3-2.

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Table 3-3. Mounting Bracket Bolt Specifications

	H-Module	M-Module	S-Module
Bolt Diameter x Length	M8x20	M6x20	M5x16
Tightening Torque	33.3 N•m 340 kgf•cm 294.7 in•lb	14.7 N•m 150 kgf•cm 130.1 in•lb	5.9 N•m 60 kgf•cm 52.2 in•lb

3.5 Single-Axis Electrical Connections

If this is the only axis in the system, see the instructions below for connecting the module to an EXA, EXC, or Adept MV controller.

If you are installing a two-axis system, see “Mechanical Assembly, Adding Axis Two” starting on page 59. If you are installing a three- or four-axis system, see “Mechanical Installation, Adding Axis Three” on page 141.

EXA and EXC Electrical Connections

Connect the two barrel ends of the cable to the X-axis module as shown in Figure 3-4. These connectors have different pins sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “1-CN6 MOTOR 1” and “1-CN5 SENSOR 1”.

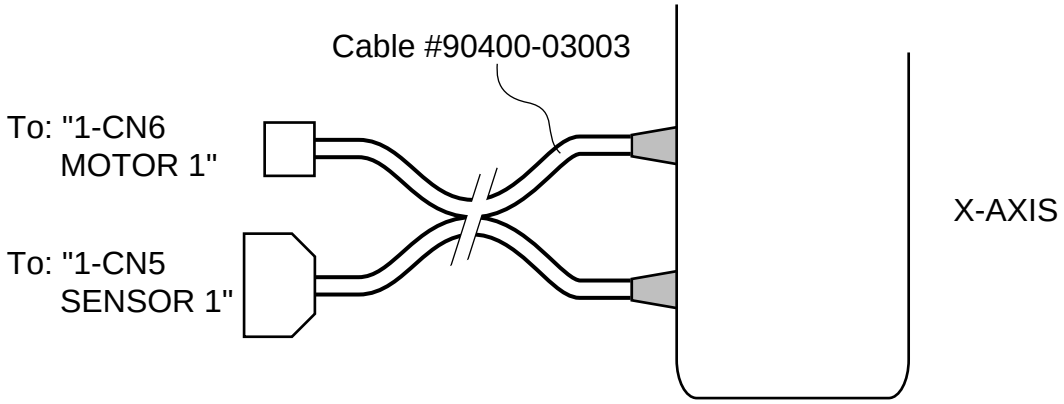


Figure 3-4. Connecting to an EXA or EXC Controller

Adept MV Controller Connections

Connect the two barrel ends of the cable to the X-axis module as shown in Figure 3-5. These connectors have different pin sizes and cannot be installed incorrectly. The D-sub connector connects to the Signal Interface Box connector marked “Axis 1”. The final connector connects to the Axis 1 end of the B Amp break-out cable.

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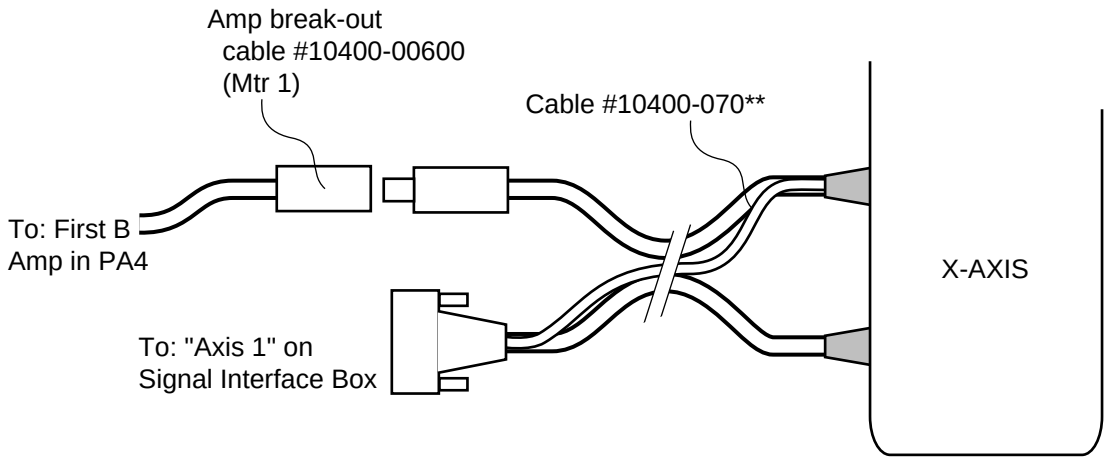


Figure 3-5. Connecting to an Adept MV Controller

3.6 Mounting Components to the Main Unit

If this is the only axis in the system, you are ready to mount your end-effector or other tooling to the module. Go to “Mounting Tooling to an AdeptModule” on page 168.

If you are installing a two-axis system, see “Mechanical Assembly, Adding Axis Two” starting on page 59. If you are installing a three- or four-axis system, see “Mechanical Installation, Adding Axis Three” starting on page 141.

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Mechanical Assembly, Adding Axis Two

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4.1 Introduction

This chapter details adding a second axis (Y-axis) to an AdeptModules system. Before beginning any procedures in this chapter you should have completed installation of the main unit as described in Chapter 3.

Precautions

Observe the following precautions when configuring modules in multi-axis combinations:

1. The mounting bracket used to connect axis two to axis one must use the mounting holes shown for that module in Chapter 8. Do not use other holes for the mounting bracket.
2. The chamfered pin of the combining bracket and the pin hole on the main unit are high-precision mating surfaces and you may experience some resistance in positioning the pin in the hole. Carefully press the bracket and main unit together firmly, using care to avoid damaging the hole in the process.
3. When assembling cables, avoid applying unreasonable force to cables.

   NOTE: Combinations other than those illustrated are possible.

4. Before applying power, check for correct cable connections.



WARNING: Improper connection may result in damage to the controller or module motor.

4.2 Combining Methods

The following instructions describe the various two-axis combination assembly procedures. There are several types of two-axis combinations, so be sure to follow the proper set of proceedures.There are six ways to combine the X-axis and Y-axis units: G, D, K, T, X, and Z. For installation procedures on your specific two-axis configuration, see the section that relates to that combination.

The combining brackets are complex components that are machined for use in several different combinations. Before installing the locator pins in the bracket, carefully compare the holes in the bracket with the holes in each module to ensure that you use the proper pin and bolt holes. The bracket dimension drawings in Chapter 8 show the proper pin and bolt holes combinations.

4.3 Robot Cables

There are two types of robot cables. One is the “straight” type and the other is the “elbow-on-one-end“ type. Figure 4-1 shows the two types of cables.

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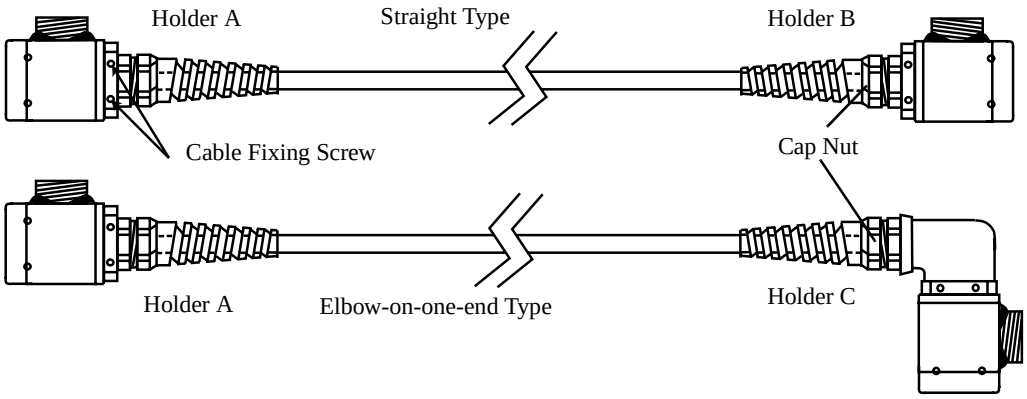


Figure 4-1. Robot Cables

Changing the Angle of the Cable End

In some AdeptModule configurations the angle of the cable holder will need to be rotated. Follow these directions to change the angle of the holder:

1. Loosen the two cable fixing screws using a M5 hex wrench.
2. Pull the elbow out approximately 5 mm (.2 inches).
3. Rotate the elbow to the desired position (do not exceed 90 degrees of rotation in either direction).
4. Push the elbow back into the socket and tighten the cable fixing screws to 1.47 N • m (13.0 in • lb).

Mounting the Cable Holder

Attach the cable holders to their respective axes using four M3 x 57 screws provided with the cable (see the following directions and Chapter 8 for holder locations), torque to 1.47 N • m (13.0 in • lb).

Inserting the Chamfered and Straight Pin Into a Bracket

Locating pins can be very helpful in positioning the Modules on the mounting surface or together. There are two types, chamfered and straight.

To insert the pins into the bracket or the module use a rubber mallet. The pins must not project more than 8 mm. For locating the position of the pins on the different types of brackets refer to “Module Dimensions” starting on page 199 of the “Technical Specifications” chapter and Figure 4-2.

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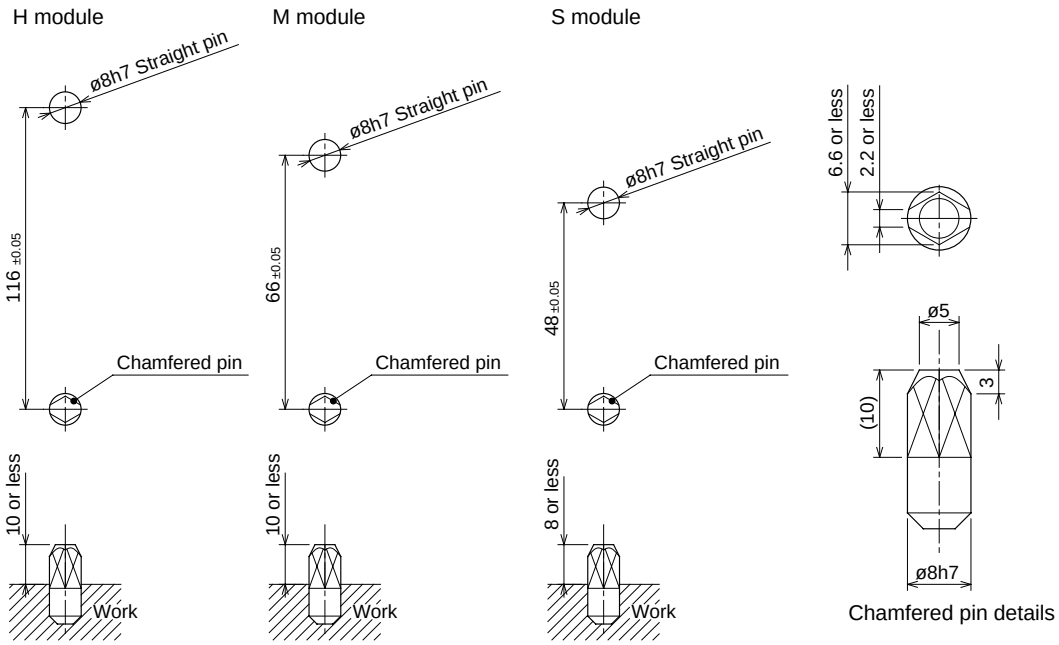


Figure 4-2. Driving the Chamfered Positioning Pins

4.4 Assembling G-Type Combinations

In a G-type configuration, the combining bracket mounts to the slider of the X-axis unit and to the body of the Y-axis unit as shown in Figure 4-3. In this configuration the sliders are perpendicular to the X-axis.

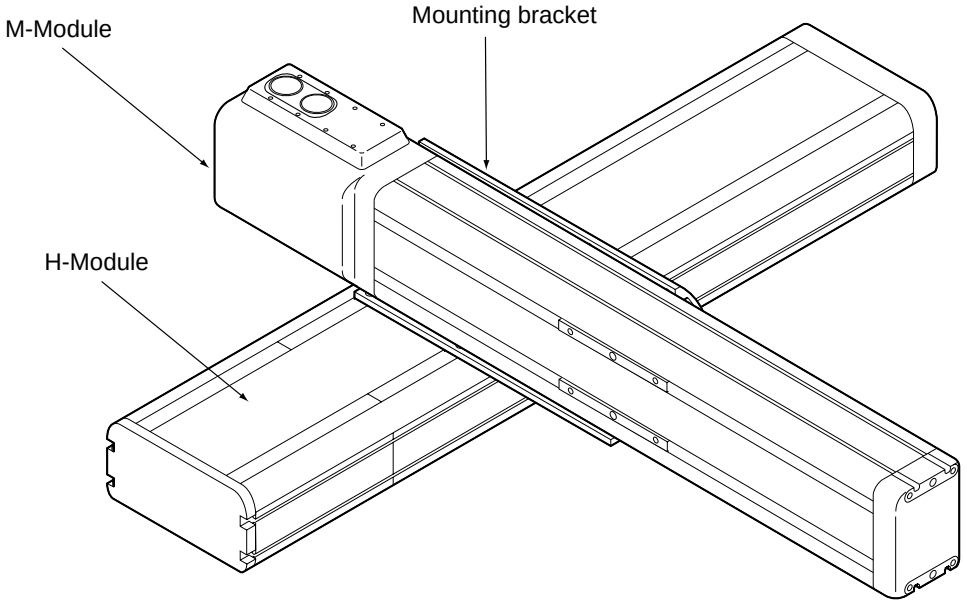


Figure 4-3. G-Type Combination

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The applicable ranges of modules and their combining brackets are shown in Table 4-1. Verify that you have compatible X-axis, Y-axis, and combining bracket components before beginning assembly.

Table 4-1. G-Type Configuration Components.

Combination Type	X-Axis Module Type and Part Numbers		Y-Axis Module Type and Part Numbers		Combining Bracket Type and Part Number	
G-1	H	90400-10**0	M	90400-200*5	GHM	90400-05002
G-2	M	90400-200*5	S	90400-300*3	GMS	90400-05001
G-3	S	90400-300*3	S	90400-300*3	GSS	90400-05003

4.5 G-1 Type Installation Procedure

1. Insert the X-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm).
2. Insert the Y-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm).
3. Mate the combining bracket to the X-axis slider. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (refer to Table 3-3 for the mounting bolt specifications).
4. Mate the Y-axis to combining bracket by aligning the motor-side pin holes on the Y-axis module to the pins on the side of the bracket (these holes are on the side opposite the sliders). Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (see Figure 4-4, and refer to Table 3-3 for the mounting bolt specifications).

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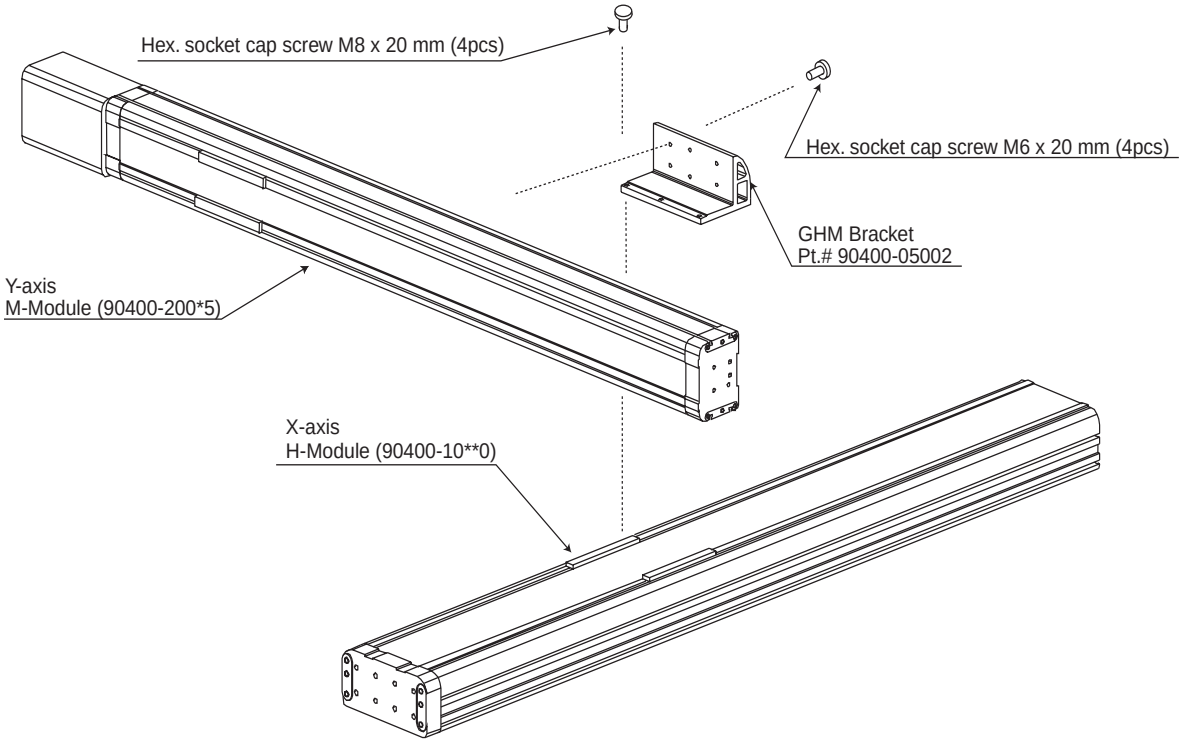


Figure 4-4. G-1 Type Mechanical Assembly

G-1 Type Electrical Connections

The applicable range of robot and controller cables is shown in Table 4-2. Verify that you have compatible cables before beginning assembly.

Table 4-2. G-1 Type Cable Options

Cable Type	EXC, EXA Controller Cable	Adept MV Interface Cable
Y-Axis Robot Cable	90400-07**5	90400-07**5
Controller Cable (1 per axis)	90400-03003	
Interface Cable (1 per axis)		10400-070**

EXA and EXC Electrical Connections

1. Connect the X-axis cables:

   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-5. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “1-CN6 MOTOR 1” and “1-CN5 SENSOR 1”.

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2. Connect the Y-axis cables:

   a. Connect the C holder end of the robot cable to the motor end of the S module (see Section 4.3 for holder mounting).

   b. Attach the A holder end of the robot cable to the side of the M module as shown in Figure 4-6 (refer to Section 4.3 for holder mounting).

   c. Connect the two barrel ends of the cable to the Y-axis module as shown in Figure 4-5. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.

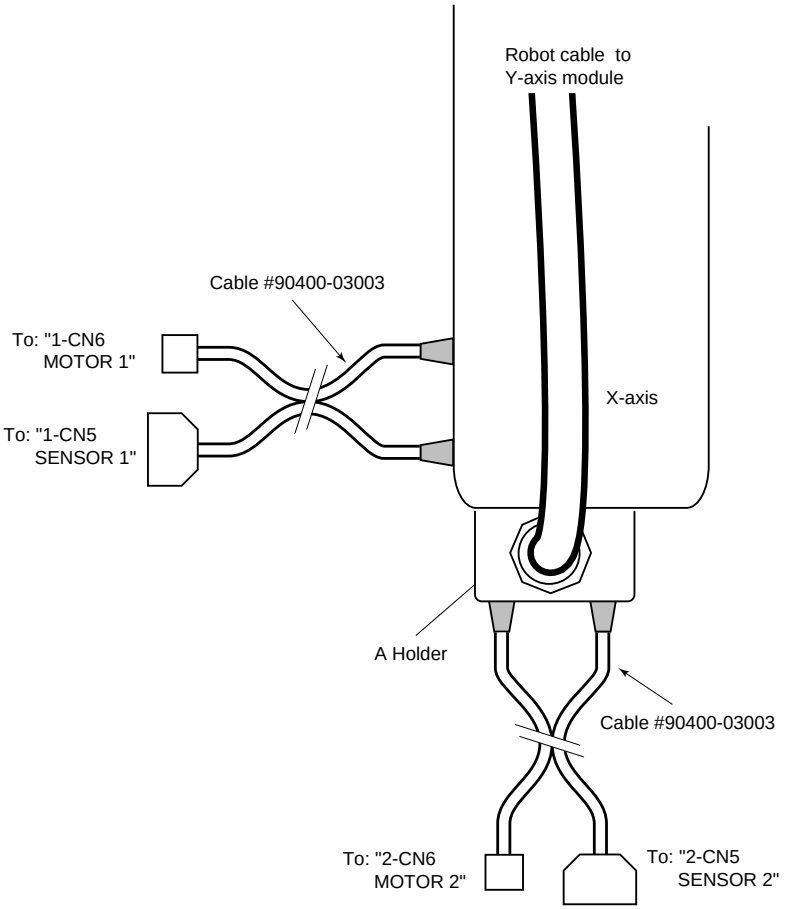


Figure 4-5. Connecting to an EXA or EXC Controller

Adept MV Controller Connections

1. Connect the X-axis cables:

   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-6. These connectors have different pin sizes and cannot be installed incorrectly.

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b. The D-sub connector connects to the Signal Interface Box connector marked "Axis 1". The final connector connects to the Axis 1 end of the Dual B+ Amp break-out cable.

2. Connect the Y-axis cables:

   a. Connect the C holder end of the robot cable to the motor end of the M module (see Section 4.3 for holder mounting).

   b. Attach the A holder end of the robot cable to the side of the H module as shown in Figure 4-6 (refer to Section 4.3 for holder mounting).

   c. Connect the two barrel ends of the cable to the A holder as shown in Figure 4-6. These connectors have different pin sizes and cannot be installed incorrectly.

   d. The D-sub connector connects to the Signal Interface Box connector marked "Axis 1".

   e. The final connector connects to the Axis 1 end of the B^+ Amp break-out cable (cable# 10400-00600).

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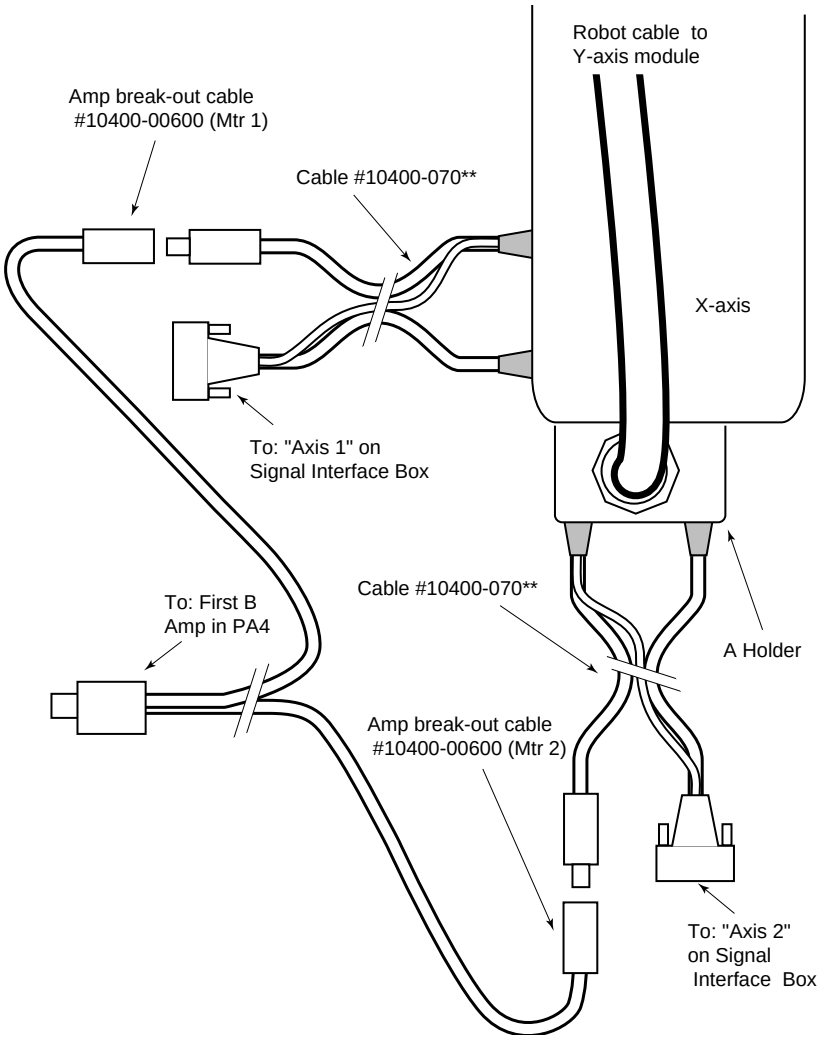


Figure 4-6. Connecting to an Adept MV Controller

4.6 G-2 Type Installation Procedure

1. Insert the X-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm).
2. Insert the Y-axis chamfered and straight pins into the bracket and seat with a rubber mallet.
3. Mate the combining bracket to the X-axis slider. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts.
4. Mate the Y-axis to combining bracket by aligning the motor-side pin holes on the Y-axis module to the pins on the side of the bracket (these holes are on the side opposite the sliders). Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (see Figure 4-7).

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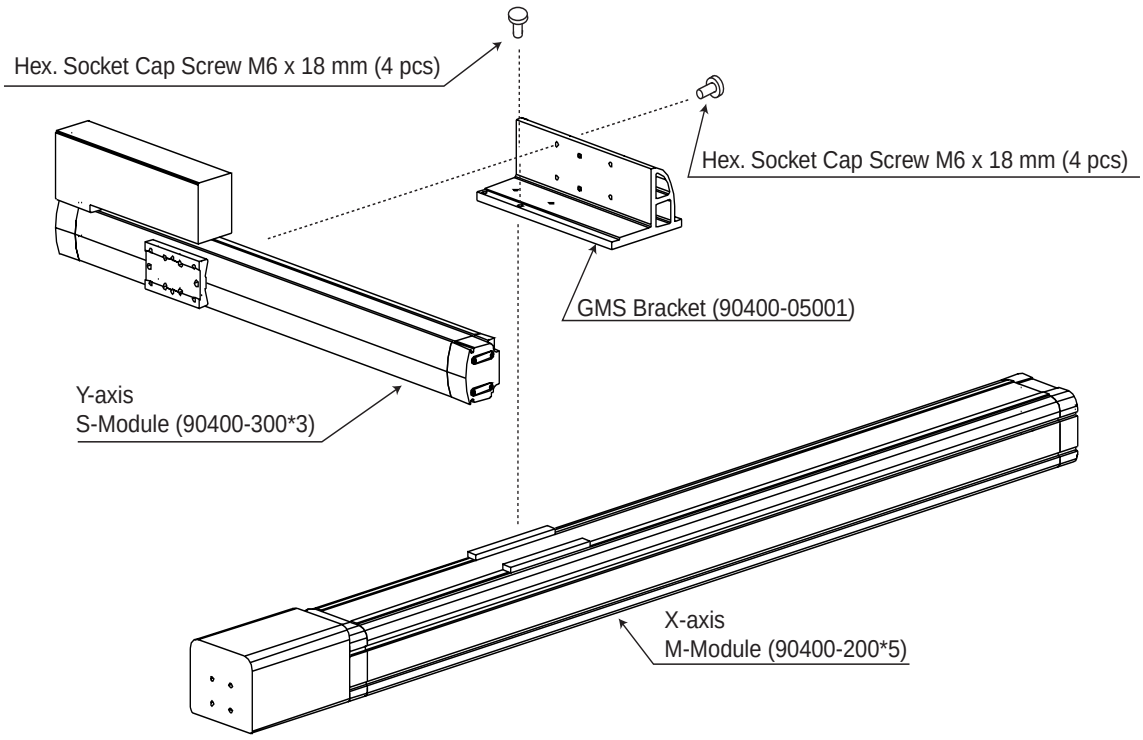


Figure 4-7. G-2 Type Mechanical Assembly

G-2 Type Electrical Connections

The applicable range of robot and controller cables is shown in Table 4-3. Verify that you have compatible cables before beginning assembly.

Table 4-3. G-2 Type Cable Options

Cable Type	EXC, EXA Controller Cable	Adept MV Interface Cable
Y-Axis Robot Cable	90400-07**5	90400-07**5
Controller Cable (1 per axis)	90400-03003	
Interface Cable (1 per axis)		10400-070**

EXA and EXC Electrical Connections

1. Connect the X-axis cables:

   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-8. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “1-CN6 MOTOR 1” and “1-CN5 SENSOR 1”.

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2. Connect the Y-axis cables:

   a. Rotate the C holder 90 degrees (refer to Section 4.3 for holder rotation).

   b. Connect the C holder end of the robot cable to the motor end of the S module (see Section 4.3 for holder mounting).

   c. Attach the A holder end of the robot cable to the side of the M module as shown in Figure 4-8 (refer to Section 4.3 for holder mounting).

   d. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).

   e. Connect the two barrel ends of the cable to the Y-axis module as shown in Figure 4-8. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.

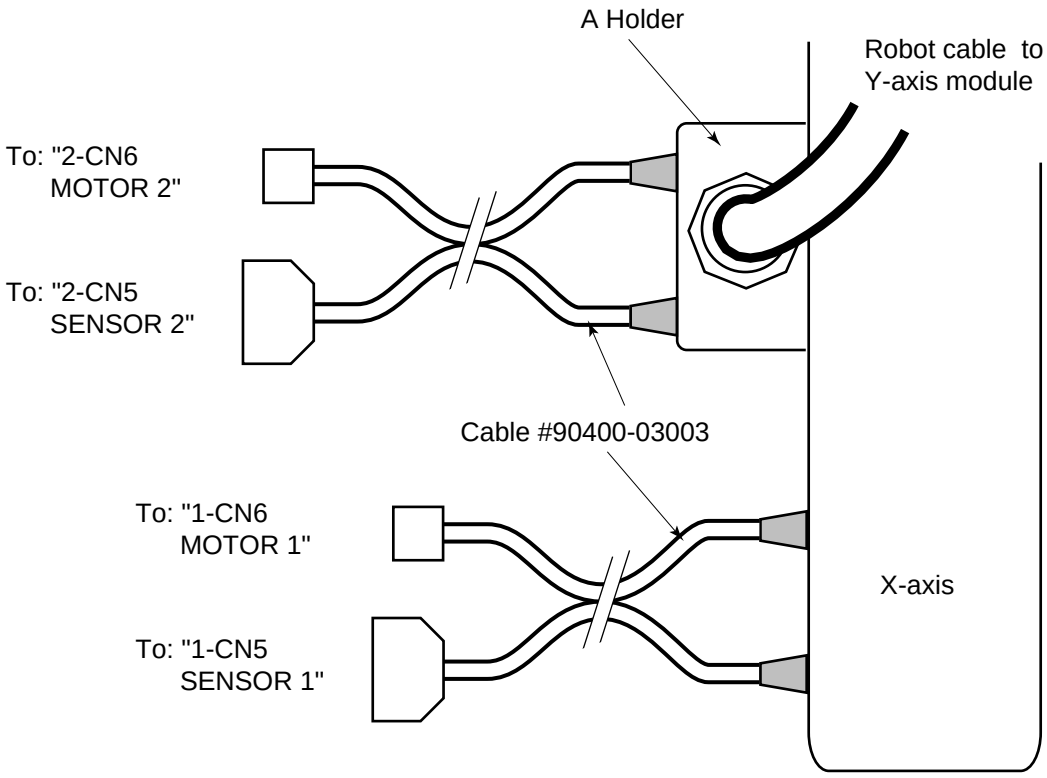


Figure 4-8. Connecting to an EXA or EXC Controller

Adept MV Controller Connections

1. Connect the X-axis cables:

   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-9. These connectors have different pin sizes and cannot be installed incorrectly.

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b. The D-sub connector connects to the Signal Interface Box connector marked "Axis 1". The final connector connects to the Axis 1 end of the B^+ Amp break-out cable.

2. Connect the Y-axis cables:

   a. Rotate the C holder 90 degrees (refer to Section 4.3 for holder rotation).

   b. Connect the C holder end of the robot cable to the motor end of the S module (refer to Section 4.3 for holder rotation and mounting).

   c. Attach the A holder end of the robot cable to the side of the M module as shown in Figure 4-9 (refer to Section 4.3 for holder rotation and mounting).

   d. Move the X-axis to the center of it movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).

   e. Connect the two barrel ends of the cable to the A holder as shown in Figure 4-9. These connectors have different pin sizes and cannot be installed incorrectly.

   f. The D-sub connector connects to the Signal Interface Box connector marked "Axis 1".

   g. The final connector connects to the Axis 1 end of the B^+ Amp break-out cable (cable# 10400-00600).

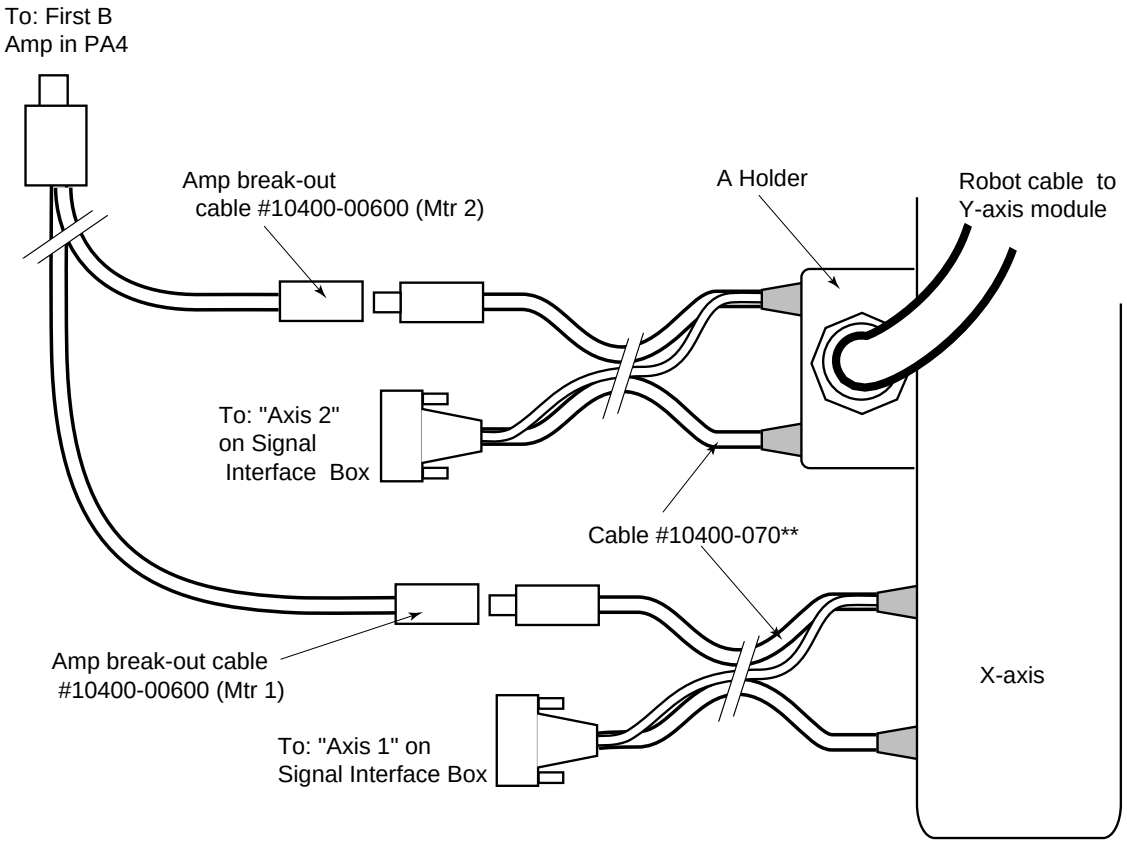


Figure 4-9. Connecting to an Adept MV Controller

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4.7 G-3 Type Installation Procedure

1. Insert the X-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm).
2. Insert the Y-axis chamfered and straight pins into the bracket and seat with a rubber mallet.
3. Mate the combining bracket to the X-axis slider. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (refer to Table 3-3 for mounting bolt specifications).
4. Mate the Y-axis to combining bracket by aligning the motor-side pin holes on the Y-axis module to the pins on the side of the bracket (these holes are on the side opposite the sliders). Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (see Figure 4-10).

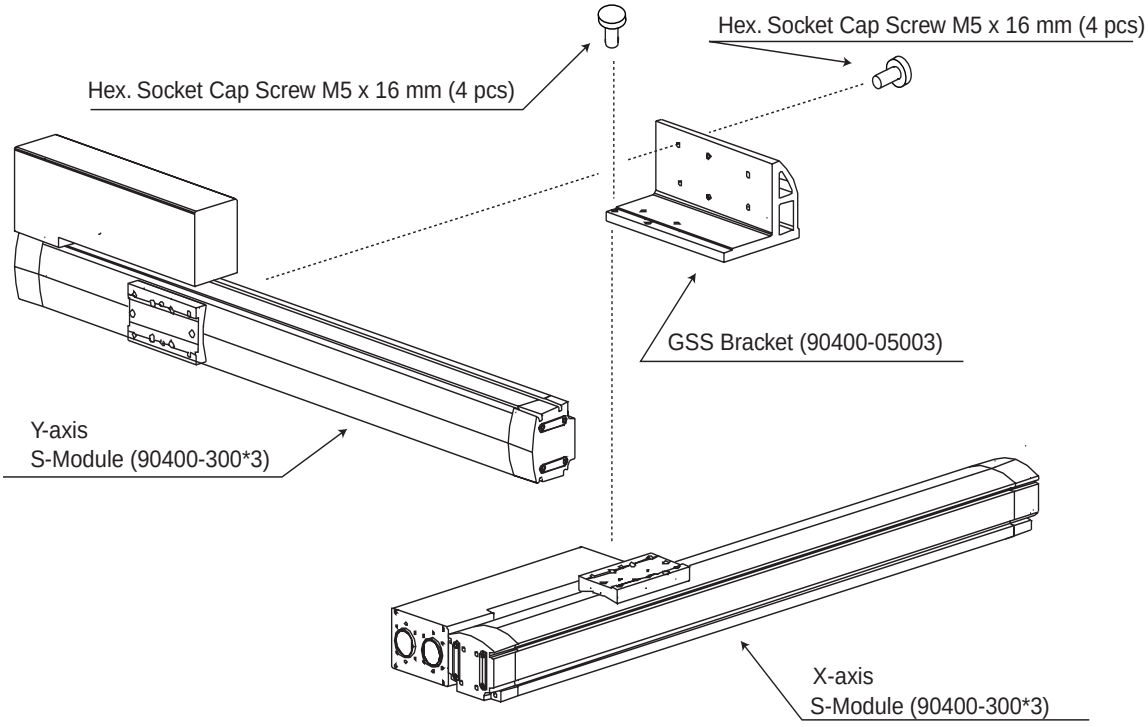


Figure 4-10. G-3 Type Mechanical Assembly

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G-3 Type Electrical Connections

The applicable range of robot and controller cables is shown in Table 4-4. Verify that you have compatible cables before beginning assembly.

Table 4-4. G-3 Type Cable Options

Cable Type	EXC, EXA Controller Cable	Adept MV Interface Cable
Y-Axis Robot Cable	90400-07**5	90400-07**5
Controller Cable (1 per axis)	90400-03003	
Interface Cable (1 per axis)		10400-070**

EXA and EXC Electrical Connections

1. Connect the X-axis cables:
   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-11. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “1-CN6 MOTOR 1” and “1-CN5 SENSOR 1”.
2. Connect the Y-axis cables:
   a. Rotate the C holder 90 degrees (refer to Section 4.3 for holder rotation).
   b. Connect the C holder end of the robot cable to the motor end of the Y-axis module (refer Section 4.3 for holder mounting).
   c. Attach the A holder end of the robot cable to the side of the X-axis module as shown in Figure 4-11 (refer to Section 4.3 for holder mounting).
   d. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).
   e. Connect the two barrel ends of the cable to the Y-axis module as shown in Figure 4-11. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.

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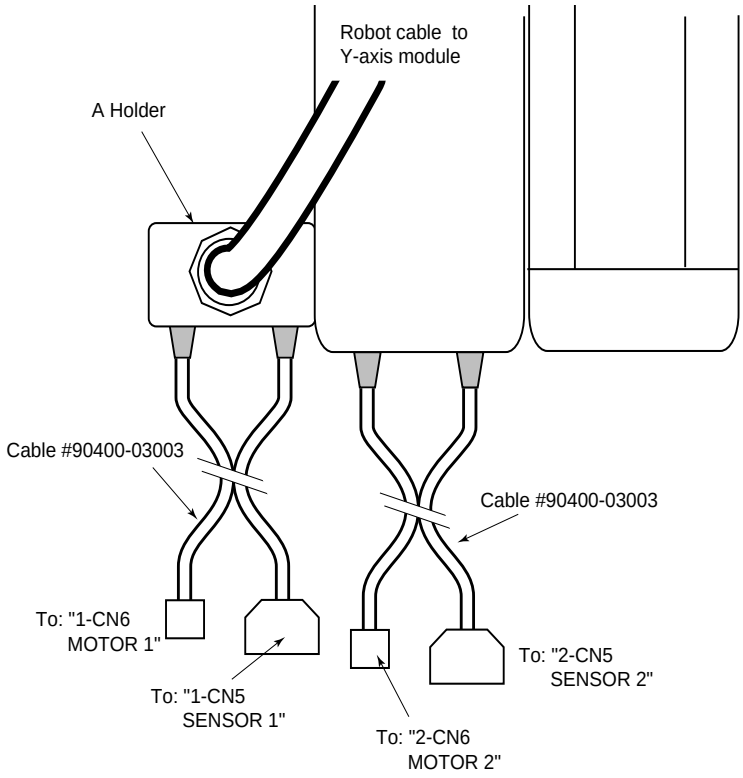


Figure 4-11. Connecting to an EXA or EXC Controller

Adept MV Controller Connections

1. Connect the X-axis cables:
   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-12. These connectors have different pin sizes and cannot be installed incorrectly.
   b. The D-sub connector connects to the Signal Interface Box connector marked "Axis 1". The final connector connects to the Axis 1 end of the B^+ Amp break-out cable.
2. Connect the Y-axis cables:
   a. Rotate the C holder 90 degrees (refer to Section 4.3 for holder rotation).
   b. Connect the C holder end of the robot cable to the motor end of the Y-axis module (refer to Section 4.3 for holder rotation and mounting).
   c. Attach the A holder end of the robot cable to the side of the X- axis module as shown in Figure 4-12 (refer to Section 4.3 for holder rotation and mounting).
   d. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).
   e. Connect the two barrel ends of the cable to the A holder as shown in Figure 4-12. These connectors have different pin sizes and cannot be installed incorrectly.

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f. The D-sub connector connects to the Signal Interface Box connector marked “Axis 1”.

g. The final connector connects to the Axis 1 end of the B^+ Amp break-out cable (cable# 10400-00600).

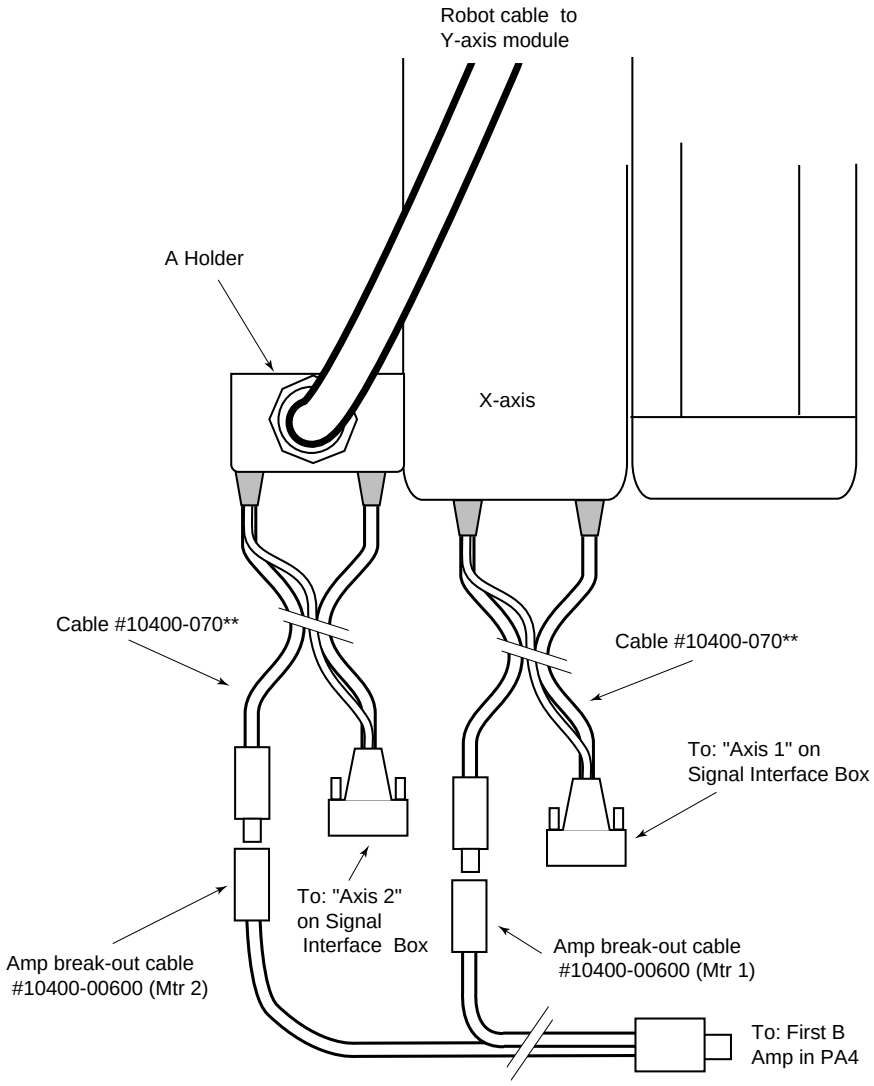


Figure 4-12. Connecting to an Adept MV Controller

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4.8 Assembling D-Type Combinations

In a D-type configuration the combining bracket mounts to the slider of the X-axis unit and to the body of the Y-axis unit as shown in Figure 4-13. In this configuration the sliders are parallel to the X-axis.

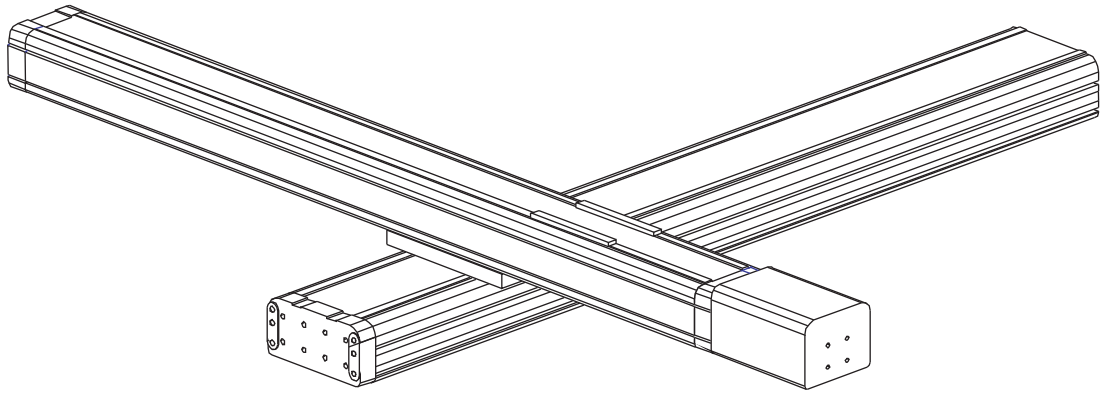


Figure 4-13. D-Type Combination

The applicable ranges of modules and their combining brackets are shown in Table 4-5. Verify that you have compatible X-axis, Y-axis, and combining bracket components before beginning assembly.

Table 4-5. D-Type Configuration Components

Combination Type	X-Axis Module Type and Part Numbers		Y-Axis Module Type and Part Numbers		Combining Bracket Type and Part Number	
D-1	H	90400-10**0	M	90400-200*5	DHM	90400-05004
D-2	M	90400-200*5	M	90400-200*5	DMM	90400-05005
D-1 Extended Stroke	H	90400-11**0	M	90400-211*5	DHM	90400-05004
D-2 Extended Stroke	M	90400-211*5	M	90400-211*5	DMM	90400-05005
D-3	M	90400-200*5	S	90400-300*3	DMS	90400-05006
D-4	S	90400-300*3	S	90400-300*3	DSS	90400-05007

NOTE: Gantry modules (pt# 90400-041**) are recommended by Adept when stroke lengths exceed 950 mm in the Y-axis.

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4.9 D-1 and D-2 Type Installation Procedure

The D-1 combination type connects an H module with an M module. The D-2 type combination connects two M modules.

1. Insert the X-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm).
2. Insert the Y-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm).
3. Mate the combining bracket to the X-axis slider. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (refer to Table 3-3 for the mounting bolt specifications).
4. Mate the Y-axis to combining bracket by aligning the motor-side pin holes on the Y-axis module to the pins on the side of the bracket (these holes are on the side opposite the sliders). Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (see Figure 4-14 or Figure 4-15, and refer to Table 3-3 for the mounting bolt specifications).

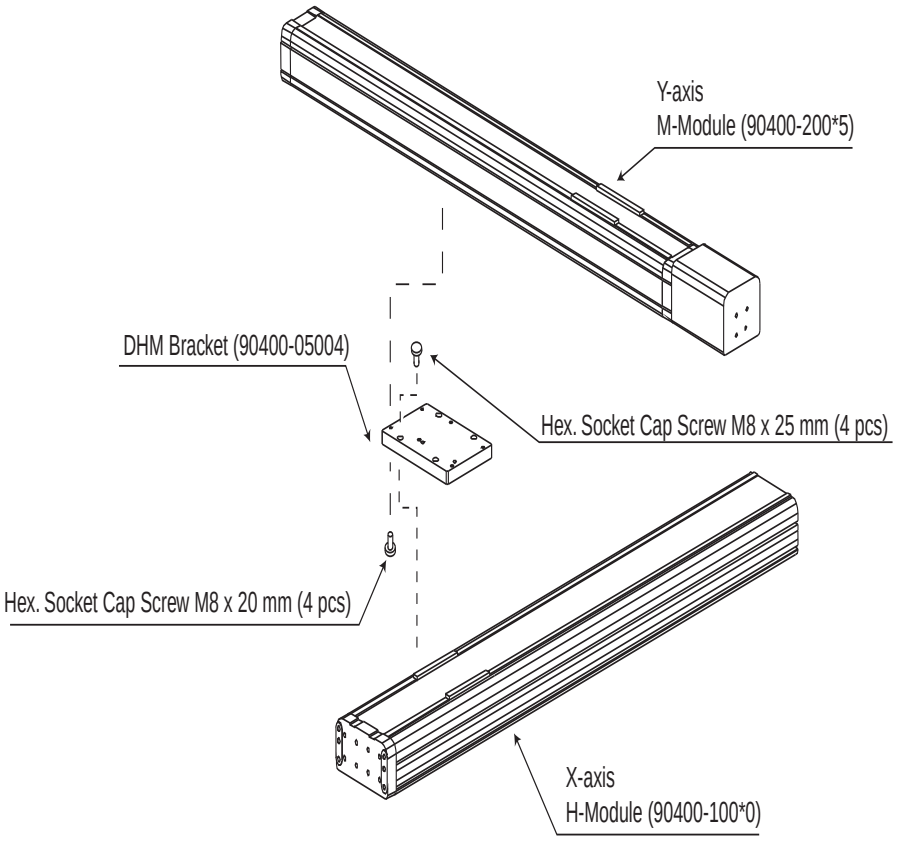


Figure 4-14. D-1 Type Mechanical Assembly

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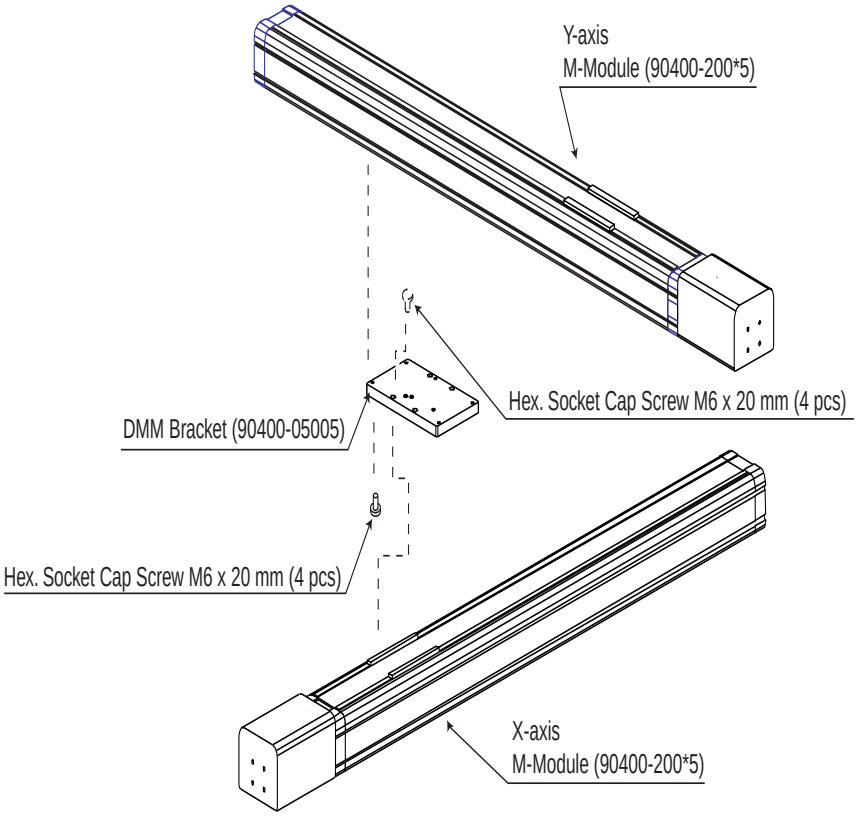


Figure 4-15. D-2 Type Mechanical Assembly

D-1 and D-2 Type Electrical Connections

The applicable ranges of robot and controller cables are shown in Table 4-6. Verify that you have compatible cables before beginning assembly.

Table 4-6. D-1 Type Cable Options

Cable Type	EXC, EXA Controller Cable	Adept MV Interface Cable
Y-Axis Robot Cable	90400-061*5	90400-07**5
Y-Axis Robot Cable tracks (extended stroke types)	90400-08008	90400-07**5
Controller Cable (1 per axis)	90400-03003	
Interface Cable (1 per axis)		10400-070**
Cable track assemble for Extended stroke models	900400-08008	

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NOTE: Adept recommends using cable tracks for extended stroke configurations. See Section 4.3 for cable track installation.

EXA and EXC Electrical Connections

1. Connect the X-axis cables:
   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-16. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “1-CN6 MOTOR 1” and “1-CN5 SENSOR 1”.
2. Connect the Y-axis cables:
   a. Connect the B holder end of the robot cable to the motor end of the Y-axis module (see Section 4.3 for holder mounting).
   b. Attach the A holder end of the robot cable to the motor end face of the X-axis module as shown in Figure 4-16 (refer to Section 4.3 for holder mounting).
   c. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).
   d. Connect the two barrel ends of the controller cable to the Y-axis module as shown in Figure 4-16. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.

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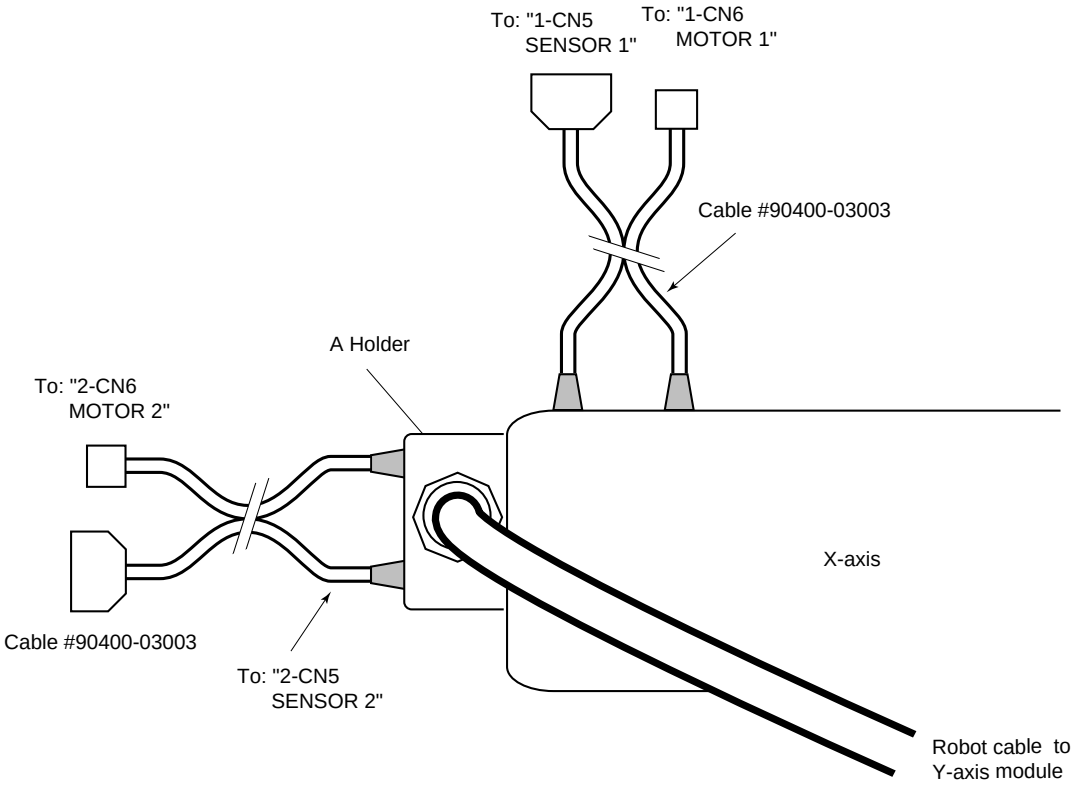


Figure 4-16. Connecting to an EXA or EXC Controller

Adept MV Controller Connections

1. Connect the X-axis cables:
   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-17. These connectors have different pin sizes and cannot be installed incorrectly.
   b. The D-sub connector connects to the Signal Interface Box connector marked "Axis 1". The final connector connects to the Axis 1 end of the B^+ Amp break-out cable.
2. Connect the Y-axis cables:
   a. Connect the B holder end of the robot cable to the motor end of the Y-axis module (see Section 4.3 for holder mounting).
   b. Attach the A holder end of the robot cable to the motor end face of the X-axis module as shown in Figure 4-17 (refer to Section 4.3 for holder mounting).

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c. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).

d. Connect the two barrel ends of the cable to the A holder as shown in Figure 4-17. These connectors have different pin sizes and cannot be installed incorrectly.

e. The D-sub connector connects to the Signal Interface Box connector marked “Axis 1”.

f. The final connector connects to the Axis 1 end of the B^+ Amp break-out cable (cable# 10400-00600).

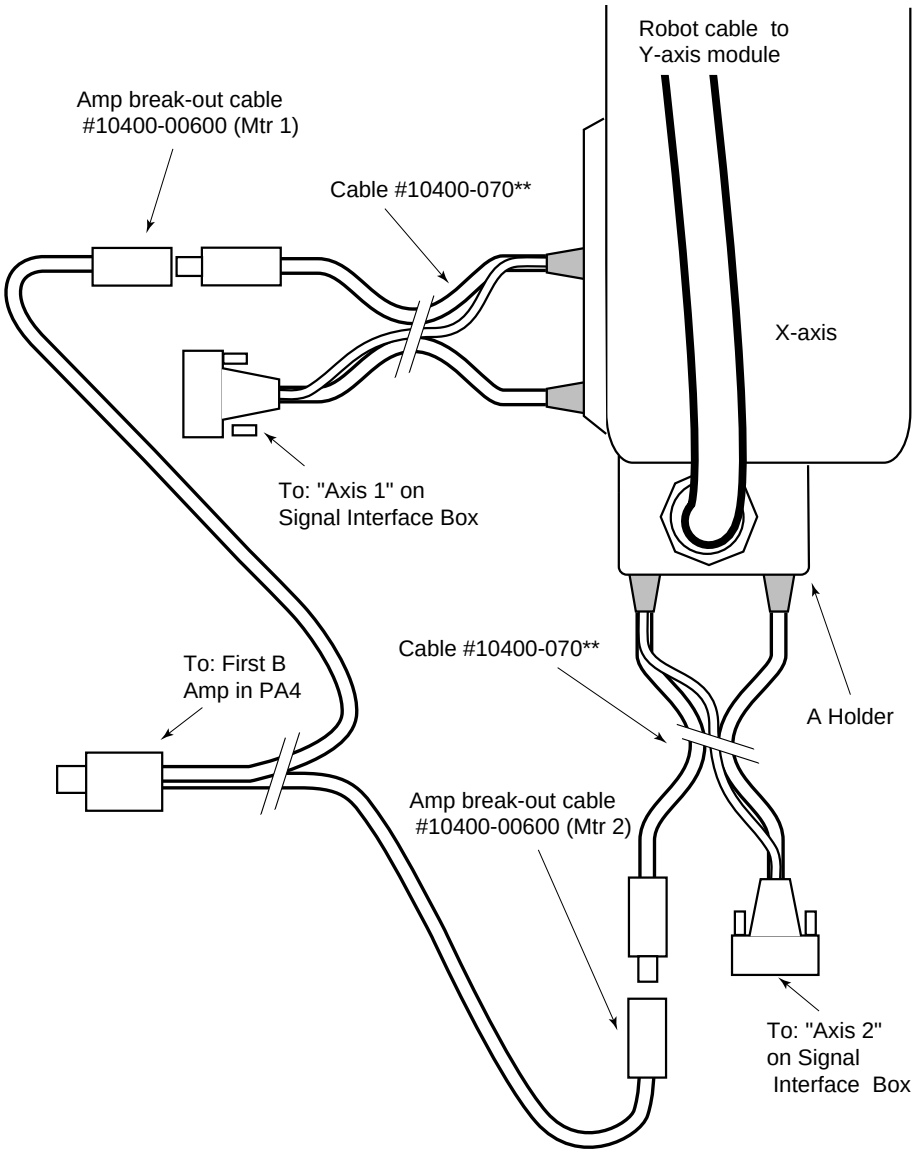


Figure 4-17. Connecting to an Adept MV Controller

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4.10 D1 and D2 Configuration Extended Stroke Cable Track Installation

When using the D1 and D2 extended stroke configurations, Adept recommends the use of cable tracks.

Follow these directions to install the cable tracks (see Figure 4-18).

1. Slide the module rail keys into the X-axis. The cable track supports mount to these keys.
2. Mount the cable track supports using M3 x 6 screws. Start with the cable track support away from the motor side of the module, torque to 1.47 N • m (13.0 in • lb).
3. Mount the remaining cable track supports and cable track support bracket (nonmoving side) to the X-axis in the same manner as steps 1 and 2.

   NOTE: In some configurations the cable track supports must be mounted to the systems base vice the X-axis. In this case Drill M6-25.4 mm tapped holes and mount supports to the base with M6 screws, 10mm long, torque to 1.47 N • m (13.0 in • lb).

   NOTE: Before mounting the cable track, insure that the cables are not twisted within the cable track.
4. Mount the cable track support bracket (moving side) with M3-6 screws to the Y-axis motor cover, torque to 1.47 N • m (13.0 in • lb).
5. Position the cable track along the X-axis cable track supports with the cable support fixture on the cable track support bracket (nonmoving side).
6. Using 4 nuts, mount the cable support fixture to the cable track support bracket (nonmoving side), torque to 1.47 N • m (13.0 in • lb).
7. Mount the other support fixture of the cable track to the cable track support bracket (moving side) with 4 screws and tapped securing plate. The securing plate is placed under the cable track support bracket, torque to 1.47 N • m (13.0 in • lb).

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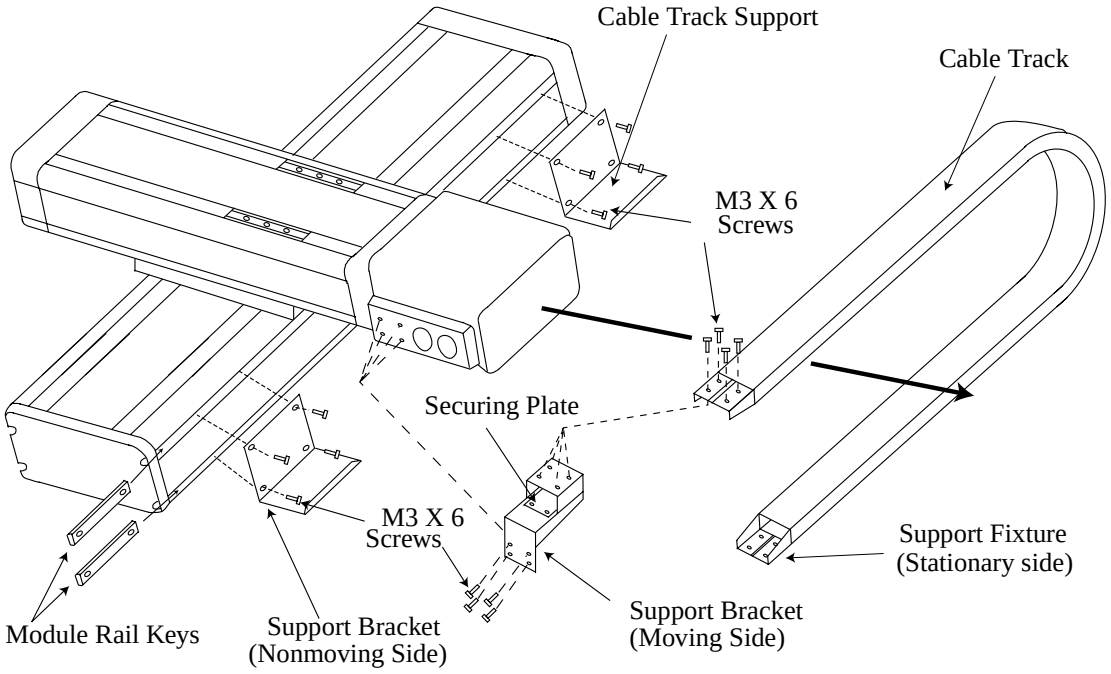


Figure 4-18. Cable Tracks

8. Connect all cable connectors to the controller and axis as describe in the above electrical connection procedures.

   NOTE: Adept recommends labeling the cables at the connectors to avoid misconnection and damage to the AdeptModules system.

Adding User Cables to the Cable Track

When adding user cables to the cable track, open the top of the cable track using a standard screw driver (see Figure 4-19). Be aware of the cross-sectional area of the cable track for the amount of space for user cables and air hoses.

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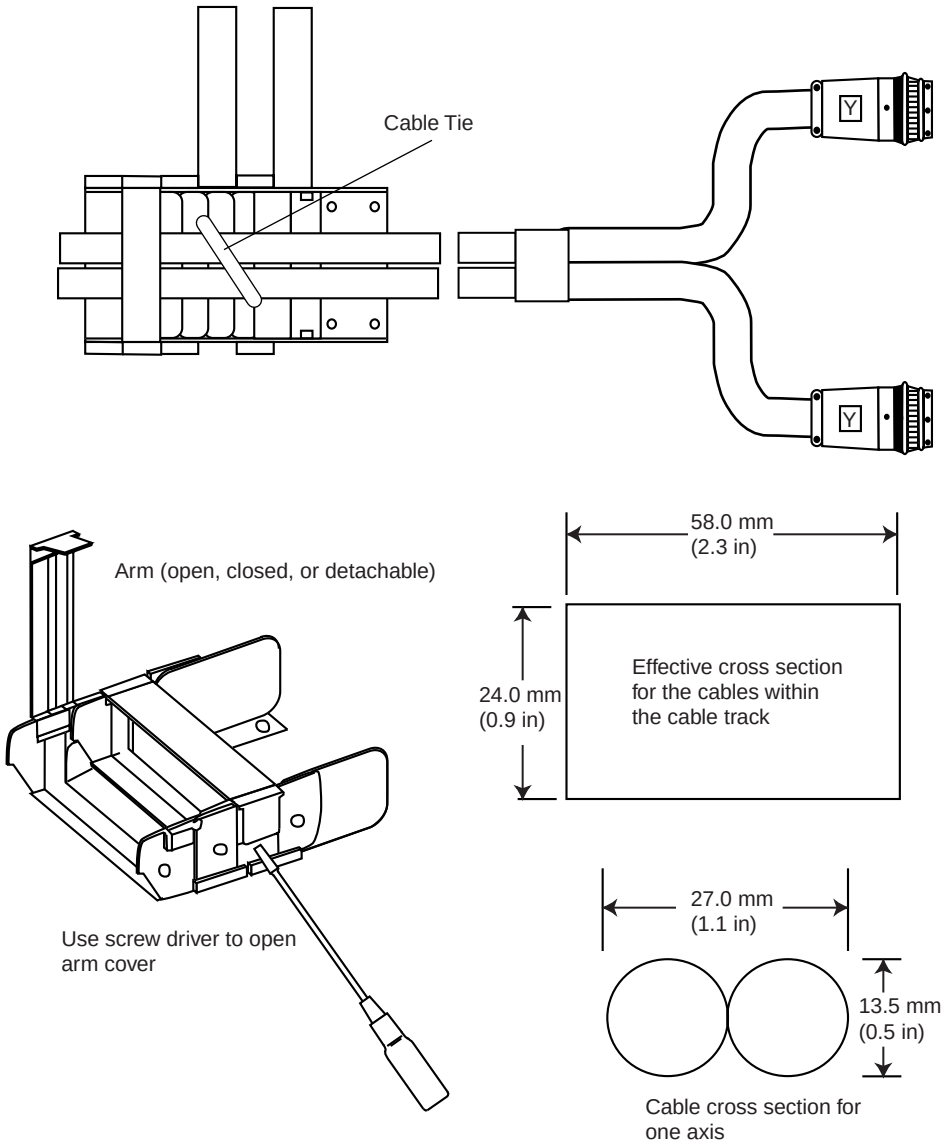


Figure 4-19. Cable Track User Cable Installation

4.11 D-3 Type Installation Procedure

The D-3 type combination connects an M module and an S module.

1. Insert the X-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm).
2. Insert the Y-axis chamfered and straight pins into the bracket and seat with a rubber mallet.
3. Carefully mate the combining bracket to the Y-axis. Do not secure with mounting bolts at this time.

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4. Mate the Y-axis with combining bracket to the X-axis slider. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (refer to Table 3-3 for mounting bolt specifications).
5. Mount the Y-axis to combining bracket. Install the mounting bolts (see Figure 4-20 and refer to Table 3-3 for mounting bolt specifications).

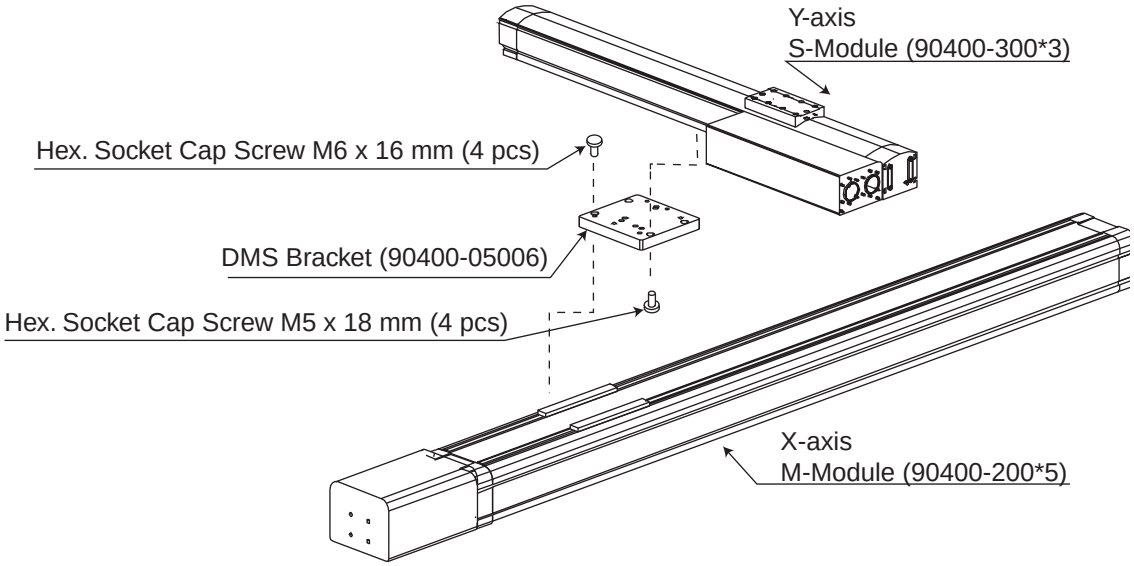


Figure 4-20. D-3 Type Mechanical Assembly

D-3 Type Electrical Connections

The applicable ranges of robot and controller cables are shown in Table 4-7. Verify that you have compatible cables before beginning assembly.

Table 4-7. D-3 Type Cable Options

Cable Type	EXC, EXA Controller Cable	Adept MV Interface Cable
Y-Axis Robot Cable	90400-07**5	90400-07**5
Controller Cable (1 per axis)	90400-03003	
Interface Cable (1 per axis)		10400-070**

EXA and EXC Electrical Connections

1. Connect the X-axis cables:

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a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-21. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “1-CN6 MOTOR 1” and “1-CN5 SENSOR 1”.

2. Connect the Y-axis cables:

a. Connect the B holder end of the robot cable to the connectors of the Y-axis module (see Section 4.3 for holder mounting).

b. Attach the A holder end of the robot cable to the motor end face of the X-axis module as shown in Figure 4-21 (refer to Section 4.3 for holder mounting).

c. Move the X-axis to the center of it movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).

d. Connect the two barrel ends of the controller cable to the Y-axis module as shown in Figure 4-21. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.

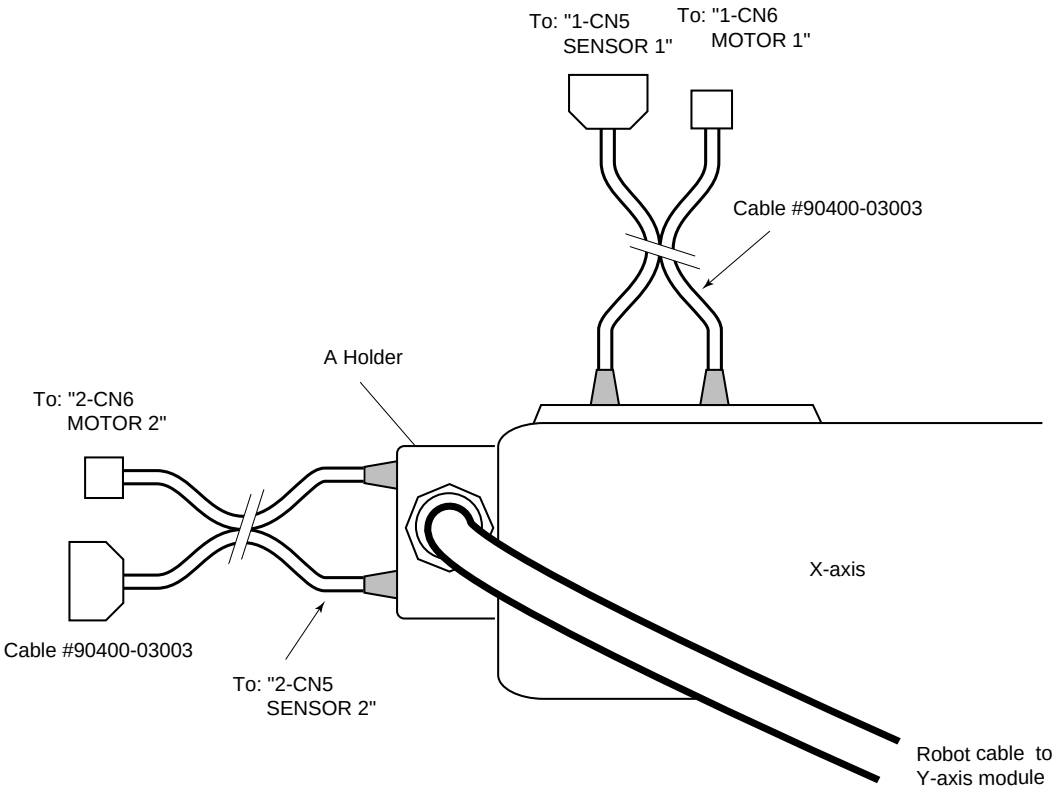


Figure 4-21. Connecting to an EXA or EXC Controller

Adept MV Controller Connections

1. Connect the X-axis cables:

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a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-22. These connectors have different pin sizes and cannot be installed incorrectly.

b. The D-sub connector connects to the Signal Interface Box connector marked “Axis 1”. The final connector connects to the Axis 1 end of the B^+ Amp break-out cable.

2. Connect the Y-axis cables:

a. Connect the B holder end of the robot cable to the motor end of the Y-axis module (see Section 4.3 for holder mounting).

b. Attach the A holder end of the robot cable to the motor end face of the X-axis module as shown in Figure 4-22 (refer to Section 4.3 for holder mounting).

c. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).

d. Connect the two barrel ends of the controller cable to the Y-axis module as shown in Figure 4-22. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.

e. The D-sub connector connects to the Signal Interface Box connector marked “Axis 1”.

f. The final connector connects to the Axis 1 end of the B^+ Amp break-out cable (cable# 10400-00600).

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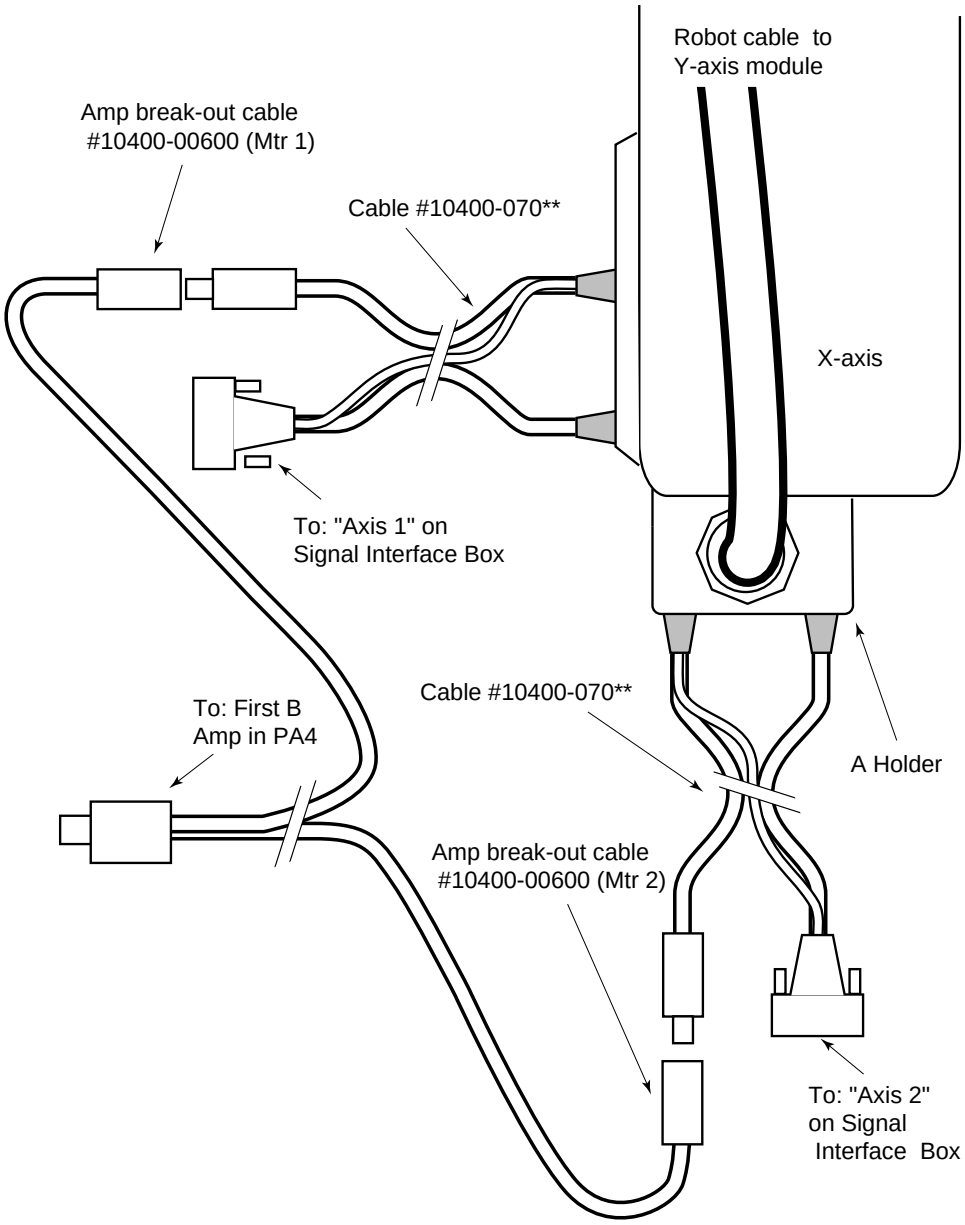


Figure 4-22. Connecting to an Adept MV Controller

4.12 D-4 Type Installation Procedure

The D-4 type connects two S modules.

1. Insert the X-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm).
2. Insert the Y-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm).

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3. Mate the combining bracket to the Y-axis rear surface. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (refer to Table 3-3 for the mounting bolt specifications).
4. Mount the Y-axis with combining bracket by aligning the pin holes on the X-axis module slider. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (see Figure 4-23, and refer to Table 3-3 for the mounting bolt specifications).

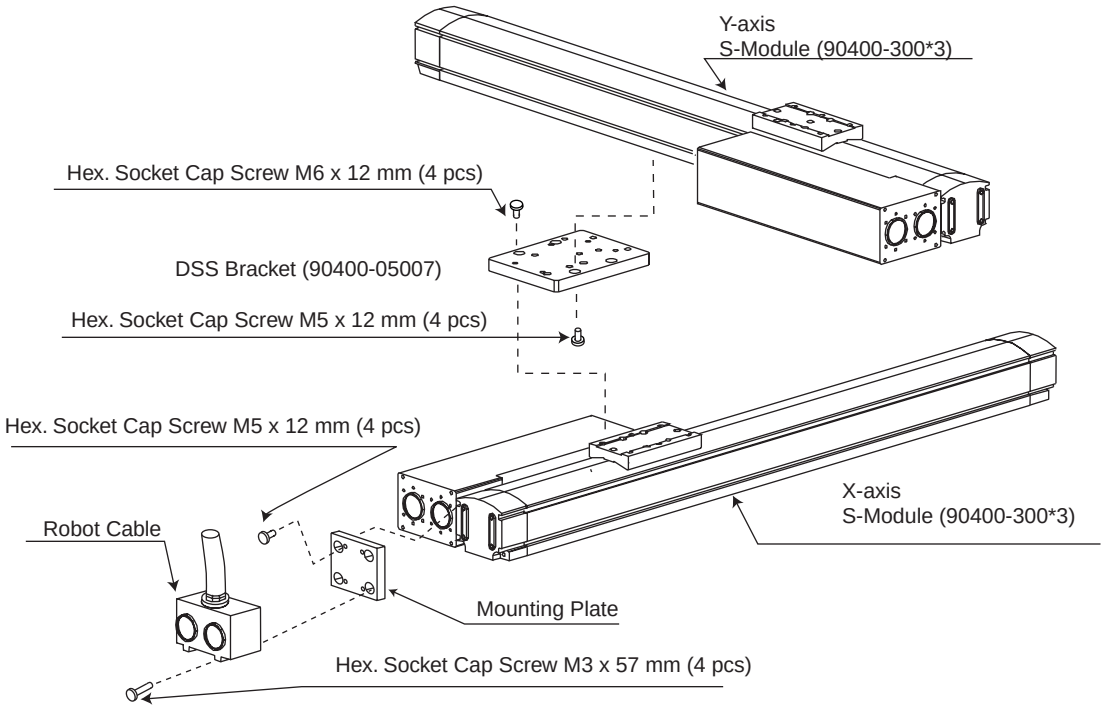


Figure 4-23. D-4 Type Mechanical Assembly

D-4 Type Electrical Connections

The applicable ranges of robot and controller cables are shown in Table 4-8. Verify that you have compatible cables before beginning assembly.

Table 4-8. D-4 Type Cable Options

Cable Type	EXC, EXA Controller Cable	Adept MV Interface Cable
Y-Axis Robot Cable	90400-07**5	90400-07**5
Controller Cable (1 per axis)	90400-03003	
Interface Cable (1 per axis)		10400-070**

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EXA and EXC Electrical Connections

1. Connect the X-axis cables:

    a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-5. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “1-CN6 MOTOR 1” and “1-CN5 SENSOR 1”.

2. Connect the Y-axis cables:

    a. Attach a small mounting plate to the X-axis motor end face plate with mounting bolts.

    a. Connect the B holder end of the robot cable to the motor end of the Y-axis module (see Section 4.3 for holder mounting).

    b. Attach the A holder end of the robot cable to the small mounting plate of the X-axis module as shown in Figure 4-24 (refer to Section 4.3 for holder mounting).

    c. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).

    d. Connect the two barrel ends of the cable to the Y-axis module as shown in Figure 4-24. These connectors have different pins sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.

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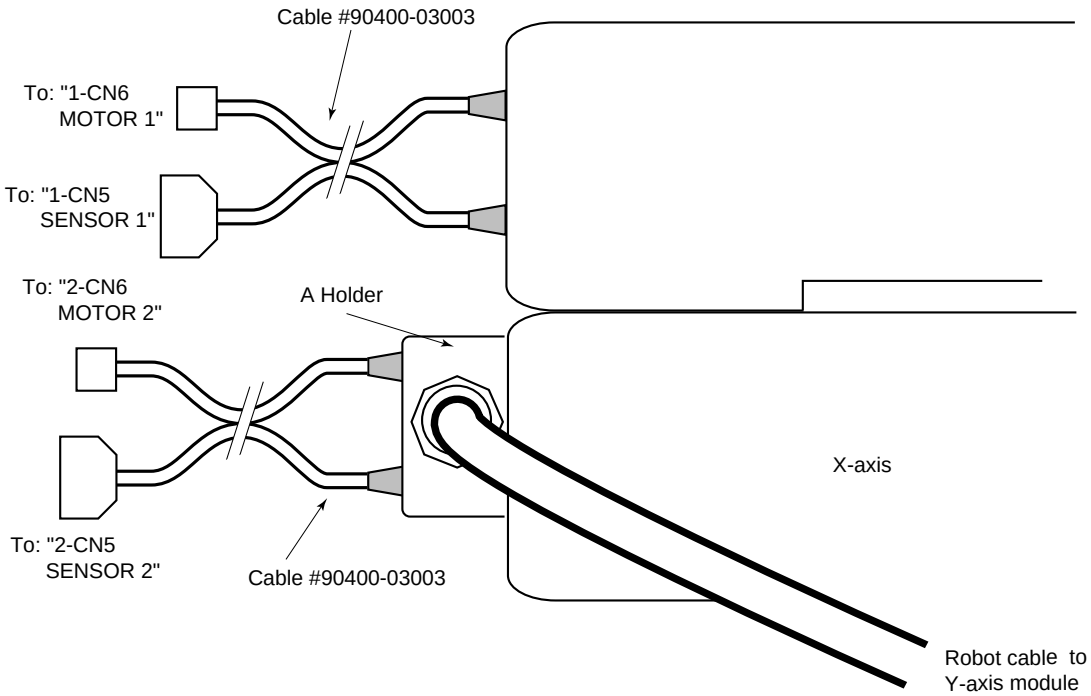


Figure 4-24. Connecting to an EXA or EXC Controller

Adept MV Controller Connections

1. Connect the X-axis cables:

   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-25. These connectors have different pins sizes and cannot be installed incorrectly.

   b. The D-sub connector connects to the Signal Interface Box connector marked "Axis 1". The final connector connects to the Axis 1 end of the B^+ Amp break-out cable.

2. Connect the Y-axis cables:

   a. Attach a small mounting plate to the X-axis motor end face plate with mounting bolts.

   a. Connect the B holder end of the robot cable to the motor end of the Y-axis module (see Section 4.3 for holder mounting).

   b. Attach the A holder end of the robot cable to the small mounting plate of the X-axis module as shown in Figure 4-25 (refer to Section 4.3 for holder mounting).

   c. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).

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d. Connect the two barrel ends of the cable to the A holder as shown in Figure 4-25. These connectors have different pins sizes and cannot be installed incorrectly.

e. The D-sub connector connects to the Signal Interface Box connector marked “Axis 1”.

f. The final connector connects to the Axis 1 end of the B^+ Amp break-out cable (cable# 10400-00600).

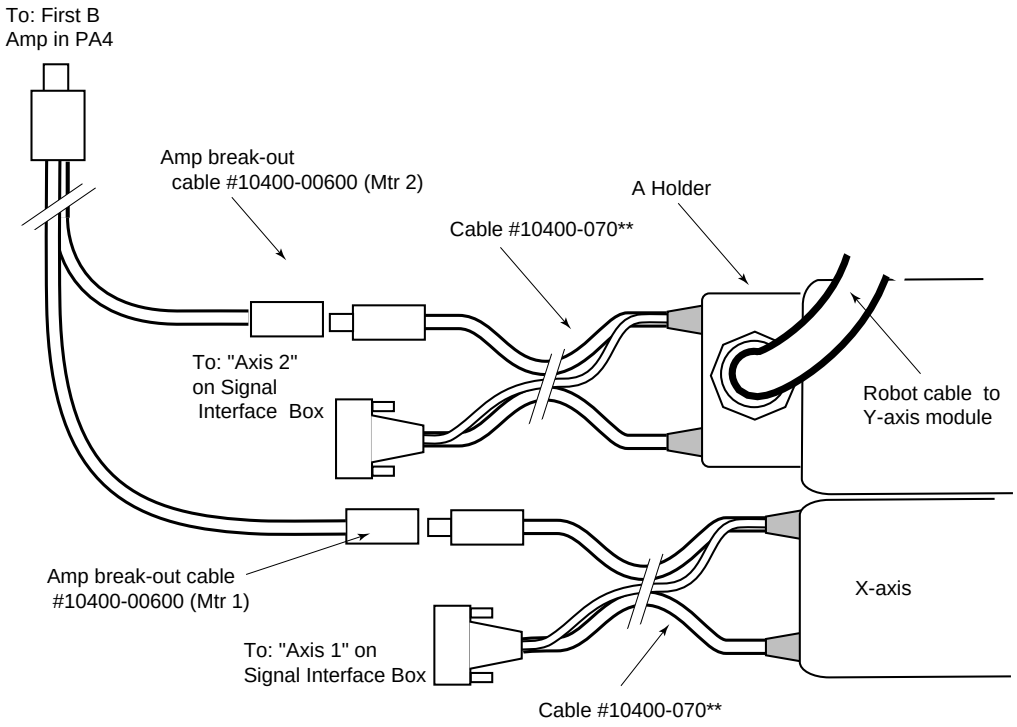


Figure 4-25. Connecting to an Adept MV Controller

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4.13 Assembling K-Type Combinations

In a K-type configuration the combining bracket mounts to the slider of the X-axis unit and to the body of the Z-axis unit as shown in Figure 4-26. In this configuration the sliders are parallel to the X-axis.

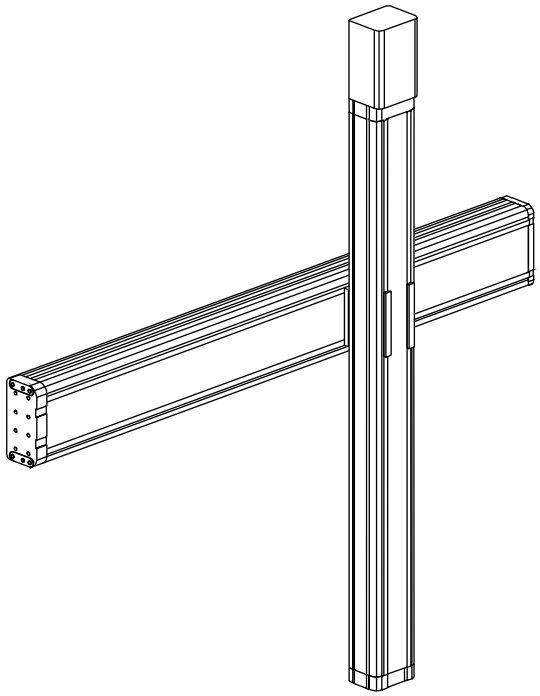


Figure 4-26. K-Type Combination

The applicable ranges of modules and their combining brackets are shown in Table 4-9. Verify that you have compatible X-axis, Z-axis, and combining bracket components before beginning assembly.

Table 4-9. K-Type Configuration Components.

Combination Type	X-Axis Module Type and Part Numbers		Y-Axis Module Type and Part Numbers		Combining Bracket Type and Part Number	
K-2	H	90400-10**0	Mz	90400-240*5	DHM	90400-05004
K-3	M	90400-10**0	Mz	90400-240*5	DMM	90400-05005
K-4	M	90400-10**0	Sz	90400-400*3	DMS	90400-05007

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4.14 K-2 Type Installation Procedure

The K-2 type combination connects an H module and an Mz module.

1. Insert the X-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm).
2. Insert the Z-axis chamfered and straight pins into the bracket and seat with a rubber mallet.
3. Carefully mate the combining bracket to the Z-axis. Do not secure with mounting bolts at this time.
4. Mate the Z-axis with combining bracket to the X-axis slider. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (refer to Table 3-3 for mounting bolt specifications).
5. Mount the Z-axis to combining bracket. Install the mounting bolts (see Figure 4-27 and refer to Table 3-3 for mounting bolt specifications).

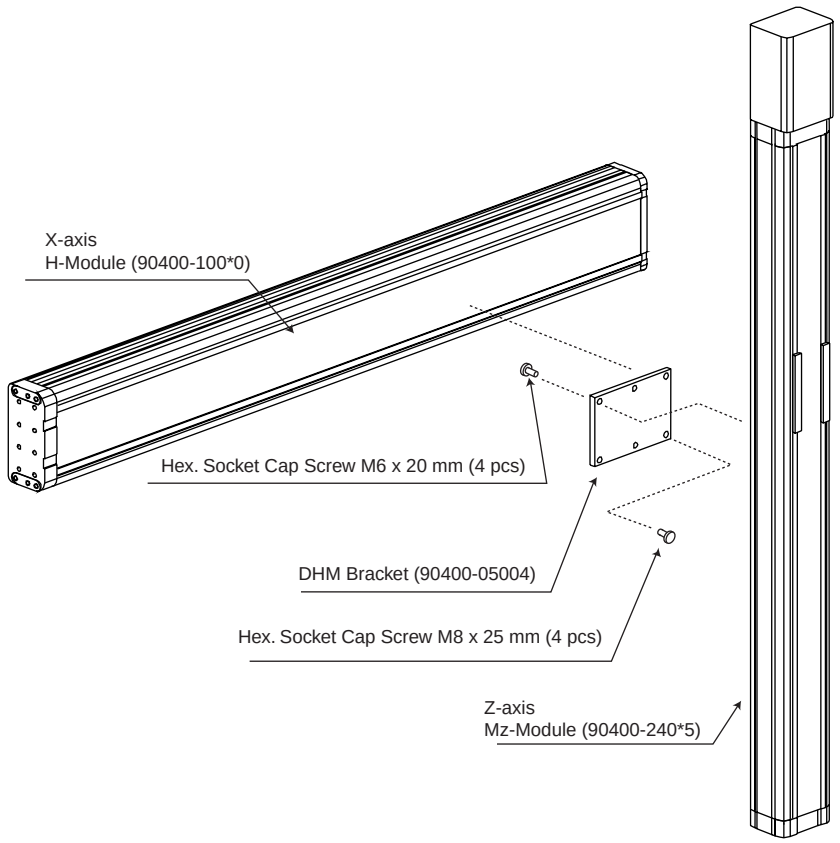


Figure 4-27. K-2 Type Mechanical Assembly

K-2 Type Electrical Connections

The applicable ranges of robot and controller cables are shown in Table 4-10. Verify that you have compatible cables before beginning assembly.

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Table 4-10. K-2 Type Cable Options

Cable Type	EXC, EXA Controller Cable	Adept MV Interface Cable
Z-Axis Robot Cable	90400-07**5	90400-07**5
Controller Cable (1 per axis)	90400-03003	
Interface Cable (1 per axis)		10400-070**

EXA and EXC Electrical Connections

1. Connect the X-axis cables:
   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-21. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “1-CN6 MOTOR 1” and “1-CN5 SENSOR 1”.
2. Connect the Z-axis cables:
   a. Connect the B holder end of the robot cable to the connectors of the Z-axis module (see Section 4.3 for holder mounting).
   b. Attach the A holder end of the robot cable to the motor end face of the X-axis module as shown in Figure 4-28 (refer to Section 4.3 for holder mounting).
   c. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).
   d. Connect the two barrel ends of the controller cable to the Z-axis robot cable holder on the X-axis module as shown in Figure 4-28. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.

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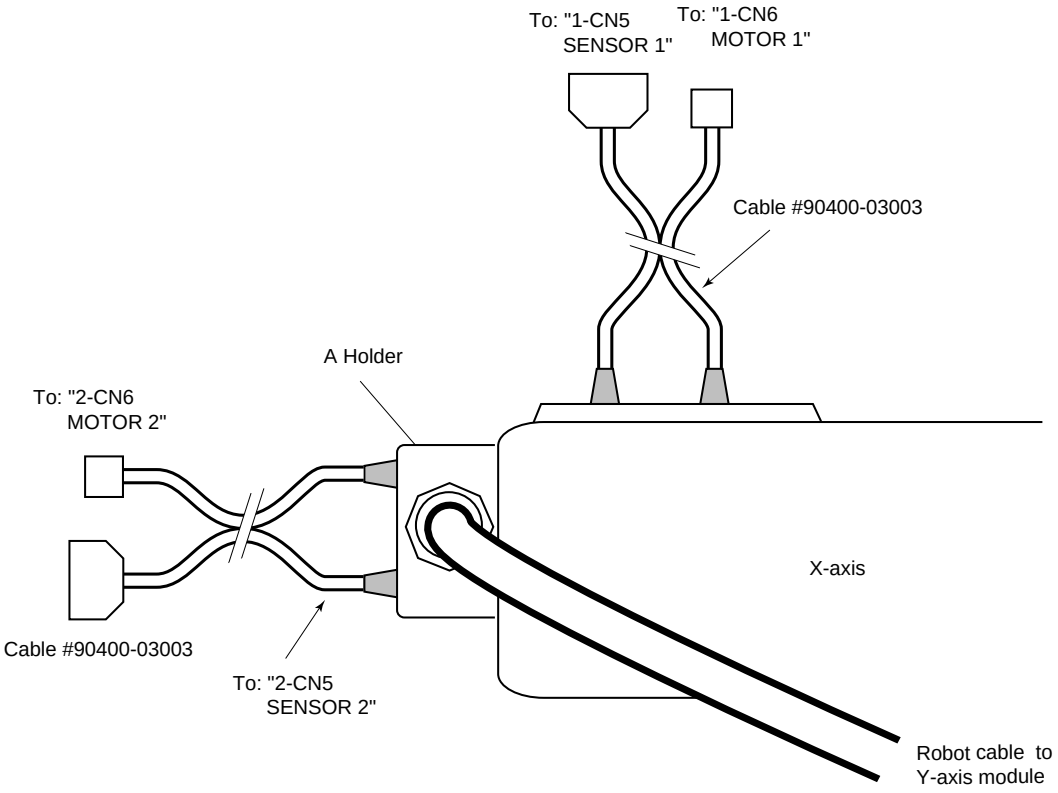


Figure 4-28. Connecting to an EXA or EXC Controller

Adept MV Controller Connections

1. Connect the X-axis cables:

   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-29. These connectors have different pin sizes and cannot be installed incorrectly.

   b. The D-sub connector connects to the Signal Interface Box connector marked "Axis 1". The final connector connects to the Axis 1 end of the B^+ Amp break-out cable.

2. Connect the Z-axis cables:

   a. Connect the B holder end of the robot cable to the motor end of the Z-axis module (see Section 4.3 for holder mounting).

   b. Attach the A holder end of the robot cable to the motor end face of the X-axis module as shown in Figure 4-29 (refer to Section 4.3 for holder mounting).

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c. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).

d. Connect the two barrel ends of the controller cable to the Z-axis robot cable holder on the X-axis module as shown in Figure 4-29. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.

e. The D-sub connector connects to the Signal Interface Box connector marked “Axis 1”.

f. The final connector connects to the Axis 1 end of the B^+ Amp break-out cable (cable# 10400-00600).

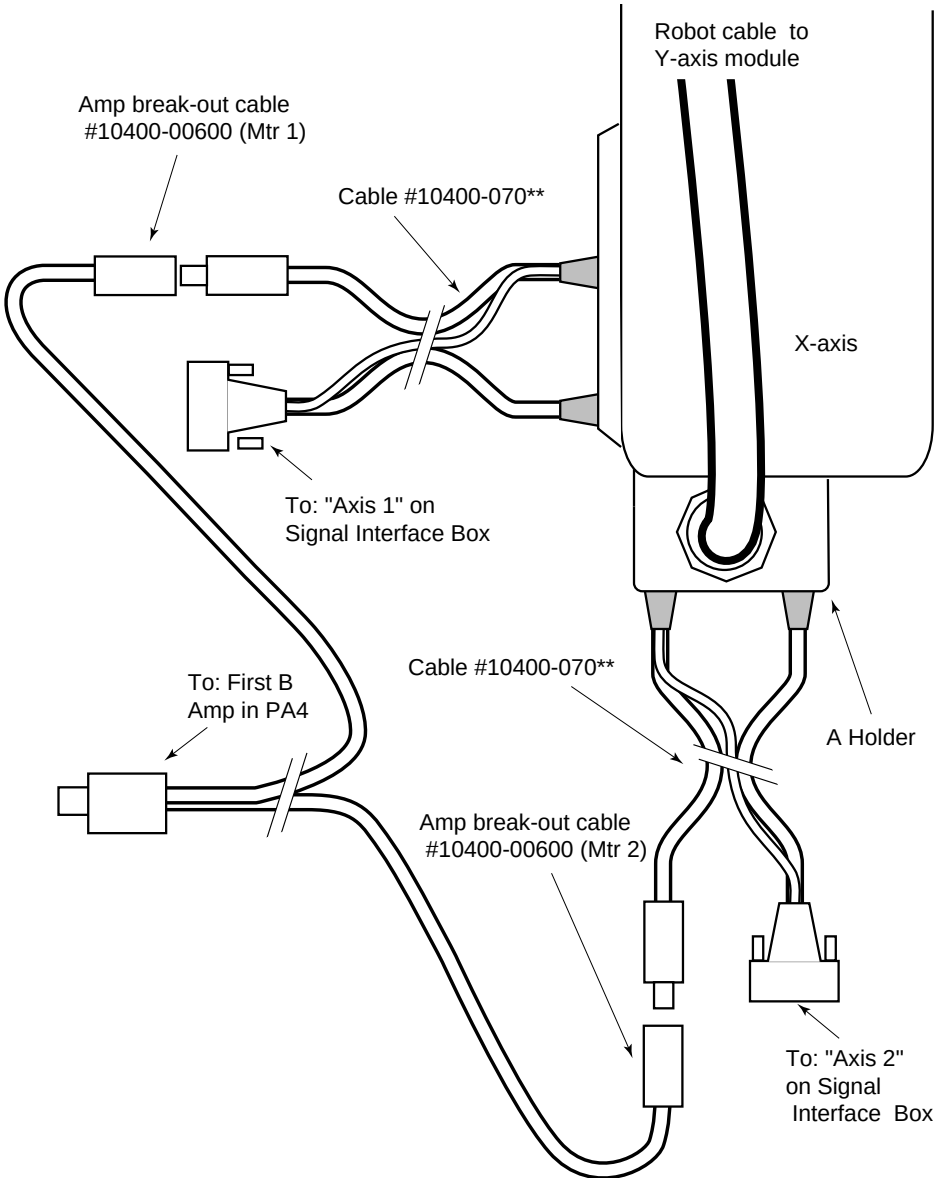


Figure 4-29. Connecting to an Adept MV Controller

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4.15 K-3 Type Installation Procedure

The K-3 type combination connects an M module and an Mz module.

1. Insert the X-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm).
2. Insert the Z-axis chamfered and straight pins into the bracket and seat with a rubber mallet.
3. Carefully mate the combining bracket to the Z-axis. Do not secure with mounting bolts at this time.
4. Mate the Z-axis with combining bracket to the X-axis slider. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (refer to Table 3-3 for mounting bolt specifications).
5. Mount the Z-axis to combining bracket. Install the mounting bolts (see Figure 4-30 and refer to Table 3-3 for mounting bolt specifications).

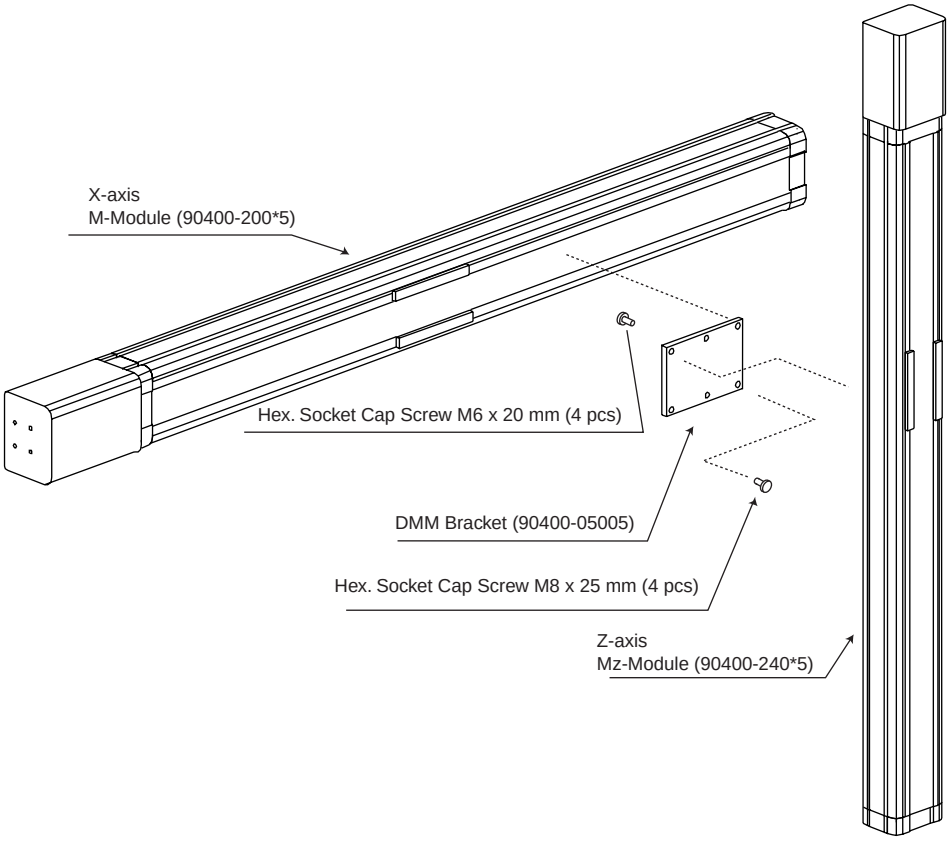


Figure 4-30. K-3 Type Mechanical Assembly

K-3 Type Electrical Connections

The applicable ranges of robot and controller cables are shown in Table 4-11. Verify that you have compatible cables before beginning assembly.

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Table 4-11. K-3 Type Cable Options

Cable Type	EXC, EXA Controller Cable	Adept MV Interface Cable
Z-Axis Robot Cable	90400-07**5	90400-07**5
Controller Cable (1 per axis)	90400-03003	
Interface Cable (1 per axis)		10400-070**

EXA and EXC Electrical Connections

1. Connect the X-axis cables:
   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-31. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “1-CN6 MOTOR 1” and “1-CN5 SENSOR 1”.
2. Connect the Z-axis cables:
   a. Connect the B holder end of the robot cable to the connectors of the Z-axis module (see Section 4.3 for holder mounting).
   b. Attach the A holder end of the robot cable to the motor end face of the X-axis module as shown in Figure 4-31 (refer to Section 4.3 for holder mounting).
   c. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).
   d. Connect the two barrel ends of the controller cable to the Z-axis robot cable holder on the X-axis module as shown in Figure 4-31. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.

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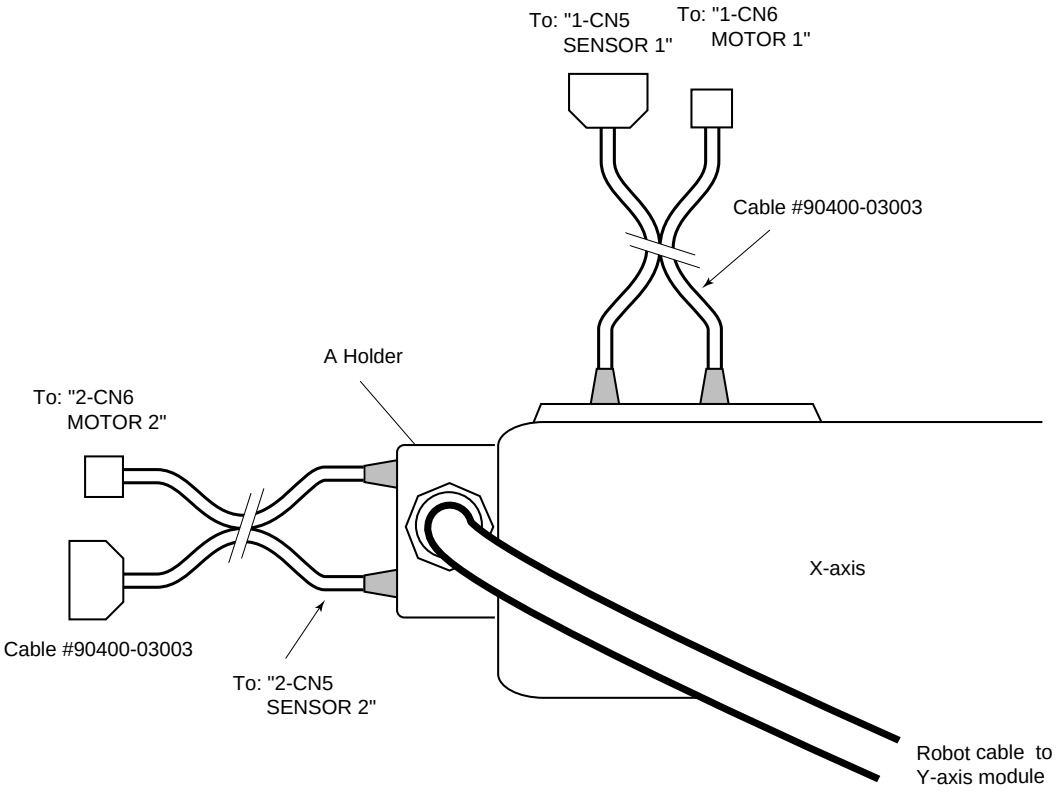


Figure 4-31. Connecting to an EXA or EXC Controller

Adept MV Controller Connections

1. Connect the X-axis cables:

   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-32. These connectors have different pin sizes and cannot be installed incorrectly.

   b. The D-sub connector connects to the Signal Interface Box connector marked "Axis 1". The final connector connects to the Axis 1 end of the B^+ Amp break-out cable.

2. Connect the Z-axis cables:

   a. Connect the B holder end of the robot cable to the motor end of the Z-axis module (see Section 4.3 for holder mounting).

   b. Attach the A holder end of the robot cable to the motor end face of the X-axis module as shown in Figure 4-32 (refer to Section 4.3 for holder mounting).

   c. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).

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d. Connect the two barrel ends of the controller cable to the Z-axis robot cable holder on the X-axis module as shown in Figure 4-32. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.

e. The D-sub connector connects to the Signal Interface Box connector marked “Axis 1”.

f. The final connector connects to the Axis 1 end of the B^+ Amp break-out cable (cable# 10400-00600).

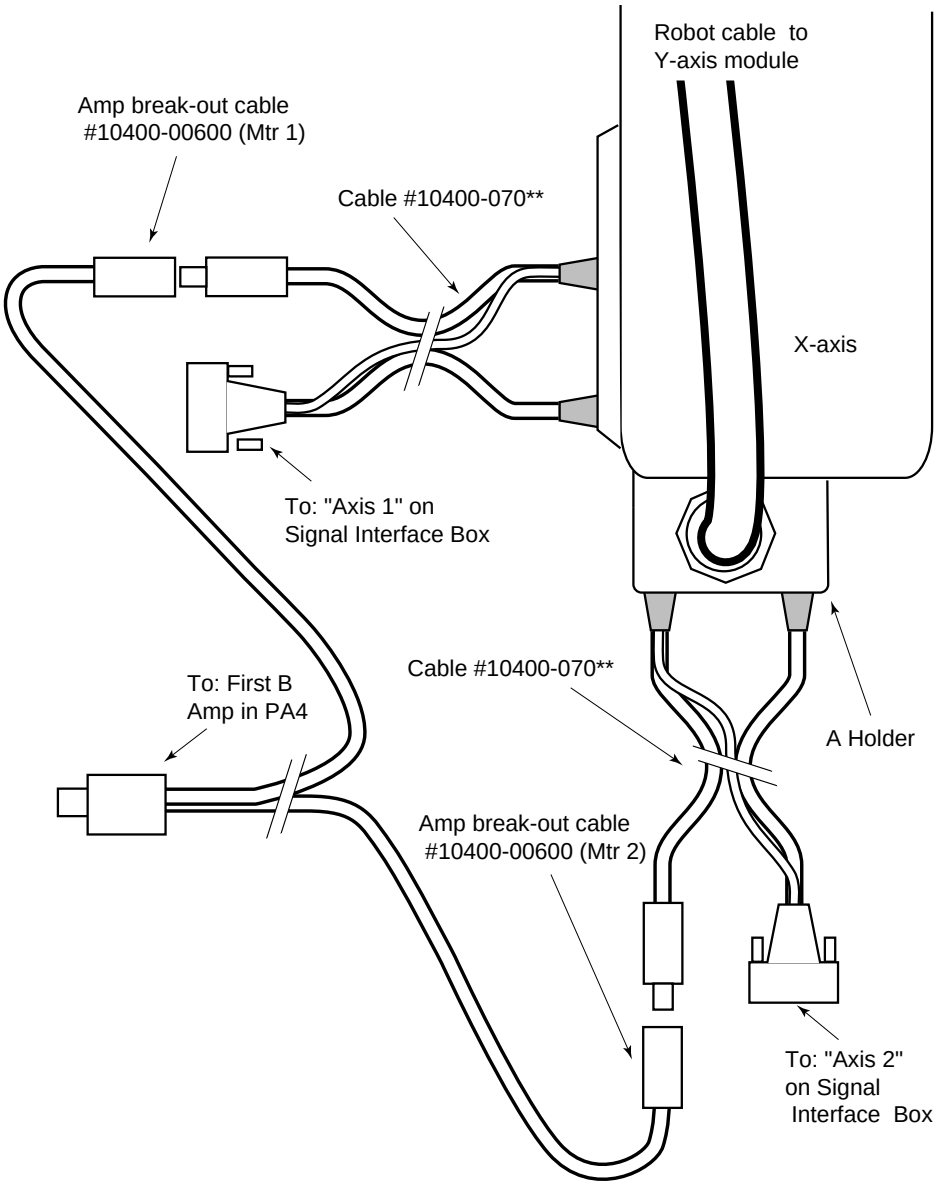


Figure 4-32. Connecting to an Adept MV Controller

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4.16 K-4 Type Installation Procedure

The K-4 type combination connects an M module and an Sz module.

1. Insert the X-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm).
2. Insert the Z-axis chamfered and straight pins into the bracket and seat with a rubber mallet.
3. Carefully mate the combining bracket to the Z-axis. Do not secure with mounting bolts at this time.
4. Mate the Z-axis with combining bracket to the X-axis slider. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (refer to Table 3-3 for mounting bolt specifications).
5. Mount the Z-axis to combining bracket. Install the mounting bolts (see Figure 4-33 and refer to Table 3-3 for mounting bolt specifications).

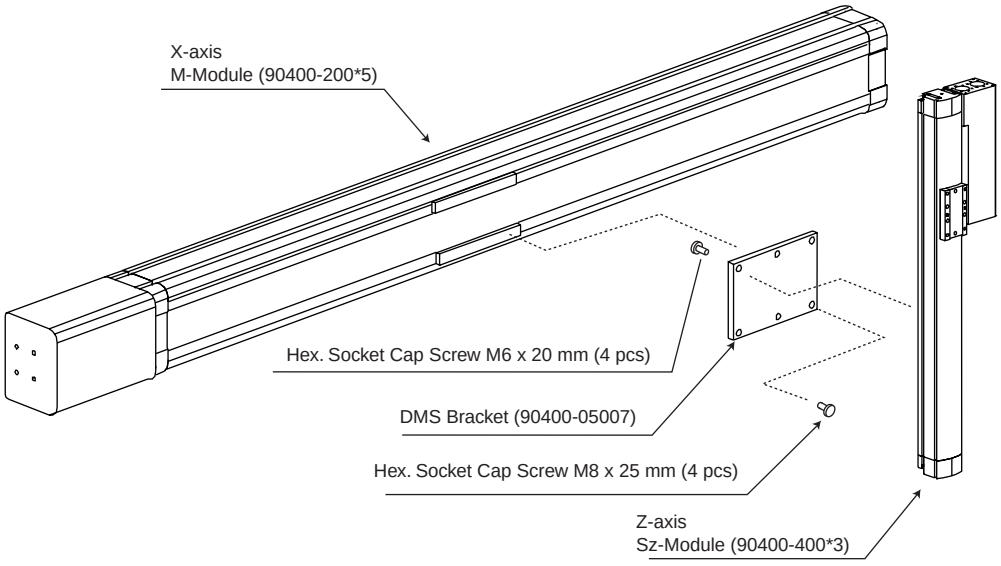


Figure 4-33. K-4 Type Mechanical Assembly

K-4 Type Electrical Connections

The applicable ranges of robot and controller cables are shown in Table 4-12. Verify that you have compatible cables before beginning assembly.

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Table 4-12. K-4 Type Cable Options

Cable Type	EXC, EXA Controller Cable	Adept MV Interface Cable
Z-Axis Robot Cable	90400-07**5	90400-07**5
Controller Cable (1 per axis)	90400-03003	
Interface Cable (1 per axis)		10400-070**

EXA and EXC Electrical Connections

1. Connect the X-axis cables:
   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-34. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “1-CN6 MOTOR 1” and “1-CN5 SENSOR 1”.
2. Connect the Z-axis cables:
   a. Connect the B holder end of the robot cable to the connectors of the Z-axis module (see Section 4.3 for holder mounting).
   b. Attach the A holder end of the robot cable to the motor end face of the X-axis module as shown in Figure 4-34 (refer to Section 4.3 for holder mounting).
   c. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m(66.4 to 79.6 in • lb).
   d. Connect the two barrel ends of the controller cable to the Z-axis robot cable holder on the X-axis module as shown in Figure 4-34. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.

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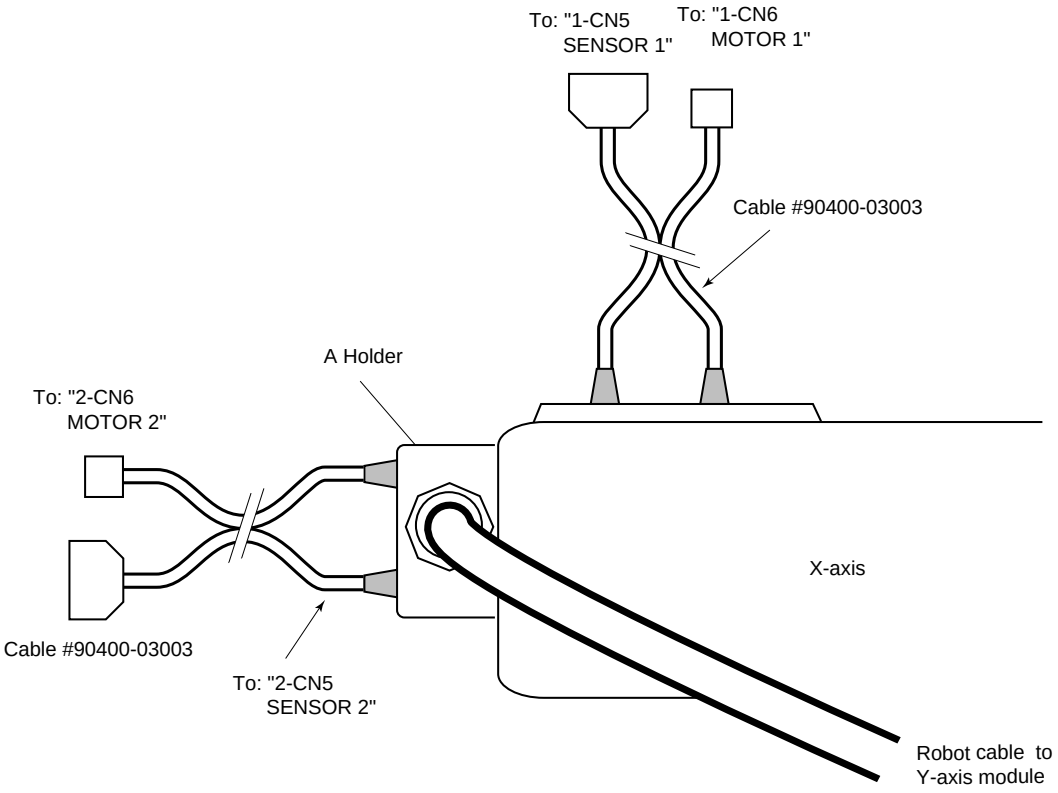


Figure 4-34. Connecting to an EXA or EXC Controller

Adept MV Controller Connections

1. Connect the X-axis cables:

   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-35. These connectors have different pin sizes and cannot be installed incorrectly.

   b. The D-sub connector connects to the Signal Interface Box connector marked "Axis 1". The final connector connects to the Axis 1 end of the B^+ Amp break-out cable.

2. Connect the Z-axis cables:

   a. Connect the B holder end of the robot cable to the motor end of the Z-axis module (see Section 4.3 for holder mounting).

   b. Attach the A holder end of the robot cable to the motor end face of the X-axis module as shown in Figure 4-35 (refer to Section 4.3 for holder mounting).

   c. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).

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d. Connect the two barrel ends of the controller cable to the Z-axis robot cable holder on the X-axis module as shown in Figure 4-35. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.

e. The D-sub connector connects to the Signal Interface Box connector marked “Axis 1”.

f. The final connector connects to the Axis 1 end of the B^+ Amp break-out cable (cable# 10400-00600).

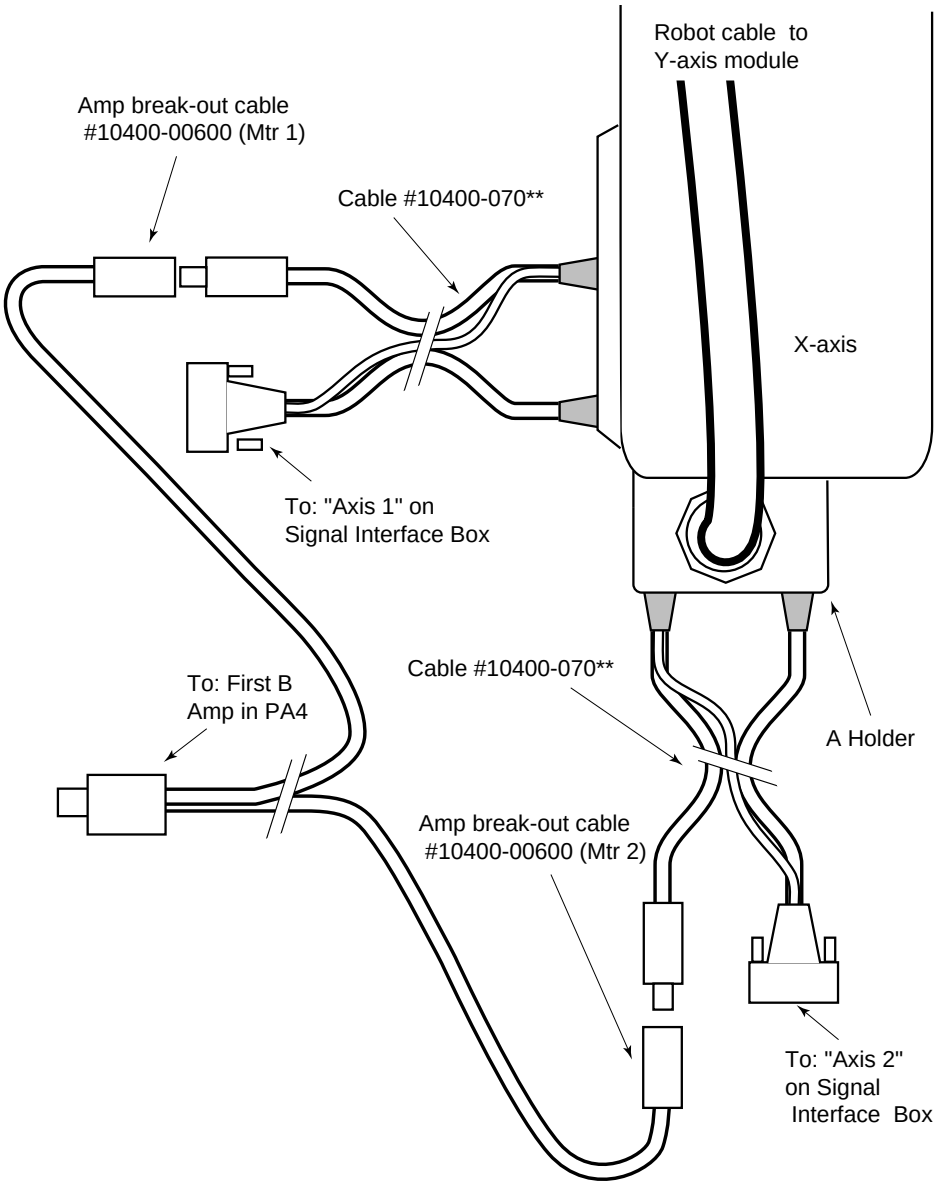


Figure 4-35. Connecting to an Adept MV Controller

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4.17 Assembling Z-Type Combinations

In a Z-type configuration the combining bracket mounts to the slider of the X-axis unit and to the slider of the Z-axis unit as shown in Figure 4-36. In this configuration the Z-axis sliders is perpendicular to the X-axis.

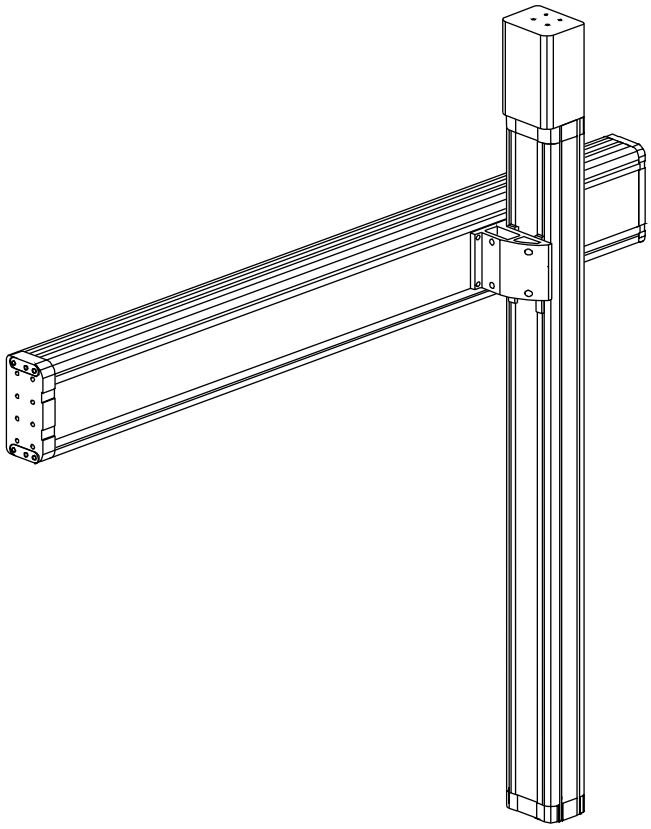


Figure 4-36. Z-Type Combination

The applicable ranges of modules and their combining brackets areshown in Table 4-13. Verify that you have compatible X-axis, Z-axis, and combining bracket components before beginning assembly.

Table 4-13. Z-Type Configuration Components.

Combination Type	X-Axis Module Type and Part Numbers		Z-Axis Module Type and Part Numbers		Combining Bracket Type and Part Number	
Z-2	H	90400-10**0	Mz	90400-240*5	XHM	90400-05008
Z-3	M	90400-10**0	Mz	90400-240*5	XMM	90400-05010
Z-4	M	90400-10**0	Sz	90400-400*3	DMS	90400-05007

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4.18 Z-2 Type Installation Procedure

The Z-2 type combination connects an H module and an Mz module.

1. Insert the X-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm).
2. Insert the Z-axis chamfered and straight pins into the bracket and seat with a rubber mallet.
3. Carefully mate the combining bracket to the Z-axis. Do not secure with mounting bolts at this time.
4. Mate the Z-axis with combining bracket to the X-axis slider. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (refer to Table 3-3 for mounting bolt specifications).
5. Mount the Z-axis to combining bracket. Install the mounting bolts (see Figure 4-37 and refer to Table 3-3 for mounting bolt specifications).

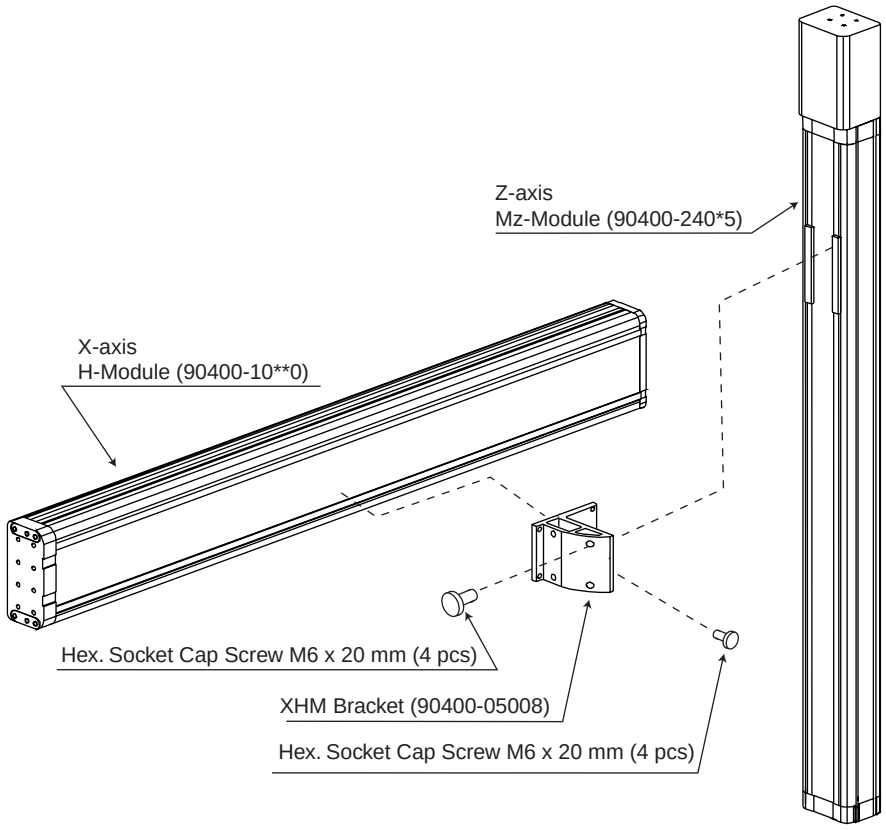


Figure 4-37. Z-2 Type Mechanical Assembly

Z-2 Type Electrical Connections

The applicable ranges of robot and controller cables are shown in Table 4-14. Verify that you have compatible cables before beginning assembly.

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Table 4-14. Z-2 Type Cable Options

Cable Type	EXC, EXA Controller Cable	Adept MV Interface Cable
Z-Axis Robot Cable	90400-07**5	90400-07**5
Controller Cable (1 per axis)	90400-03003	
Interface Cable (1 per axis)		10400-070**

EXA and EXC Electrical Connections

1. Connect the X-axis cables:
   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-38. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “1-CN6 MOTOR 1” and “1-CN5 SENSOR 1”.
2. Connect the Z-axis cables:
   a. Connect the B holder end of the robot cable to the connectors of the Z-axis module (see Section 4.3 for holder mounting).
   b. Attach the A holder end of the robot cable to the motor end face of the X-axis module as shown in Figure 4-38 (refer to Section 4.3 for holder mounting).
   c. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).
   d. Connect the two barrel ends of the controller cable to the Z-axis robot cable holder on the X-axis module as shown in Figure 4-38. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.

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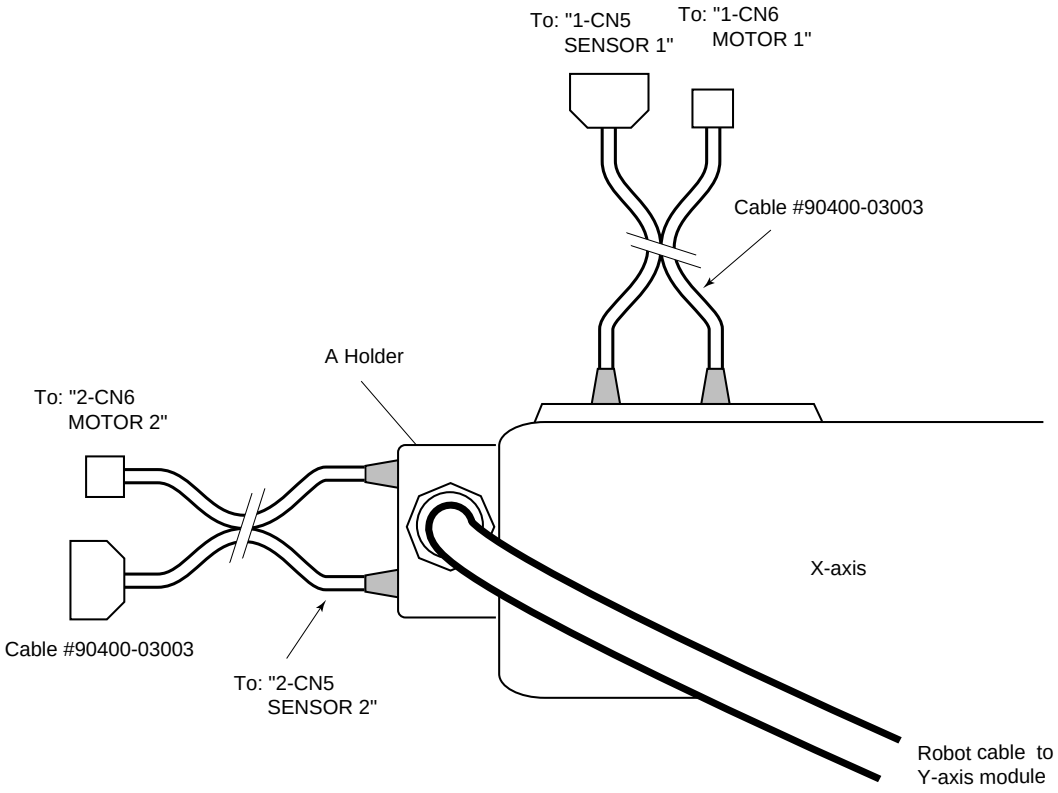


Figure 4-38. Connecting to an EXA or EXC Controller

Adept MV Controller Connections

1. Connect the X-axis cables:

   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-39. These connectors have different pin sizes and cannot be installed incorrectly.

   b. The D-sub connector connects to the Signal Interface Box connector marked "Axis 1". The final connector connects to the Axis 1 end of the B^+ Amp break-out cable.

2. Connect the Z-axis cables:

   a. Connect the B holder end of the robot cable to the motor end of the Z-axis module (see Section 4.3 for holder mounting).

   b. Attach the A holder end of the robot cable to the motor end face of the X-axis module as shown in Figure 4-39 (refer to Section 4.3 for holder mounting).

   c. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).

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d. Connect the two barrel ends of the controller cable to the Z-axis robot cable holder on the X-axis module as shown in Figure 4-39. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.

e. The D-sub connector connects to the Signal Interface Box connector marked “Axis 1”.

f. The final connector connects to the Axis 1 end of the B^+ Amp break-out cable (cable# 10400-00600).

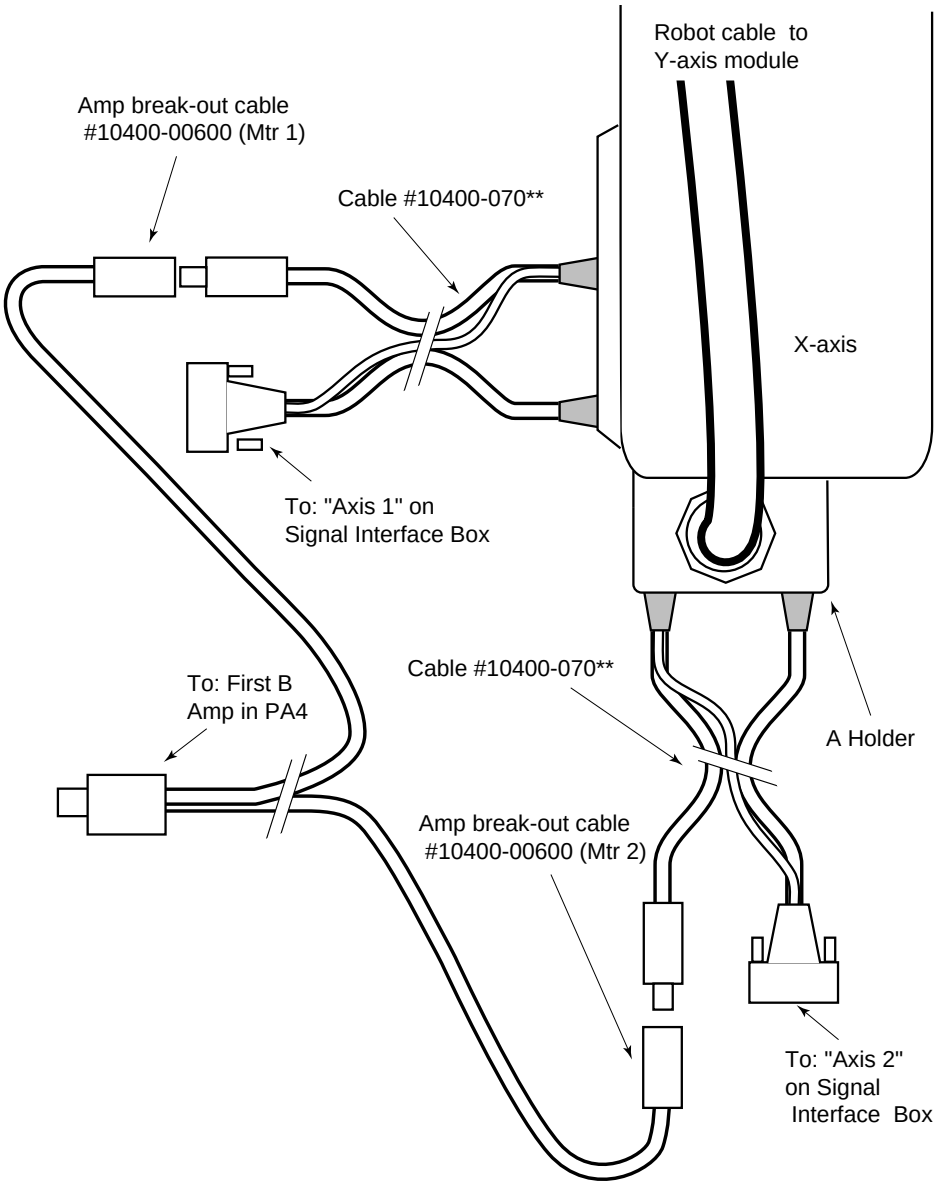


Figure 4-39. Connecting to an Adept MV Controller

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4.19 Z-3 Type Installation Procedure

The K-3 type combination connects an M module and an Mz module.

1. Insert the X-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm).
2. Insert the Z-axis chamfered and straight pins into the bracket and seat with a rubber mallet.
3. Carefully mate the combining bracket to the Z-axis. Do not secure with mounting bolts at this time.
4. Mate the Z-axis with combining bracket to the X-axis slider. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (refer to Table 3-3 for mounting bolt specifications).
5. Mount the Z-axis to combining bracket. Install the mounting bolts (see Figure 4-40 and refer to Table 3-3 for mounting bolt specifications).

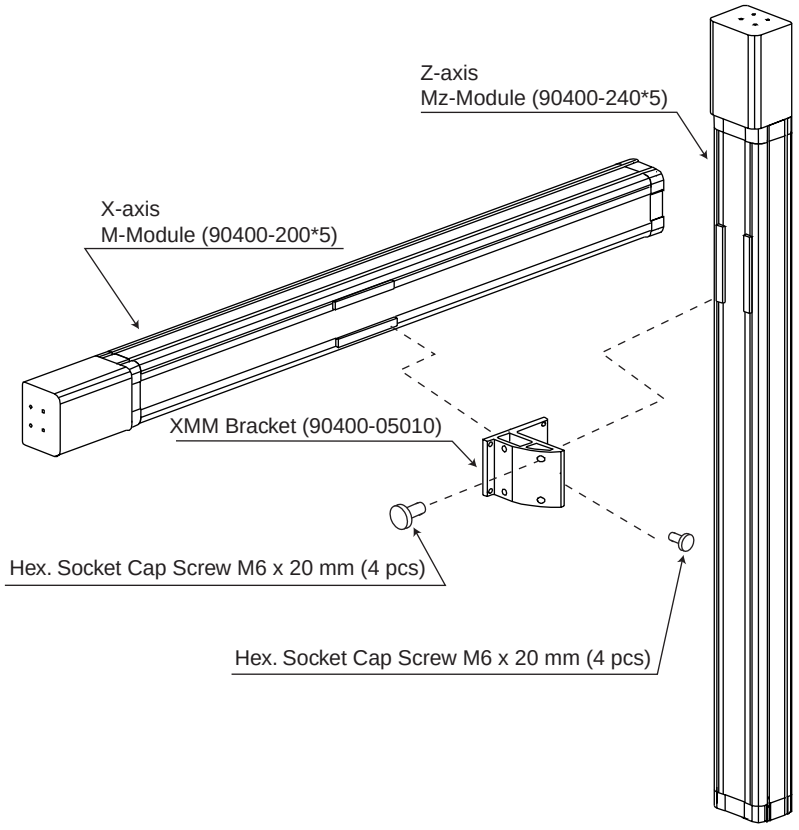


Figure 4-40. Z-3 Type Mechanical Assembly

Z-3 Type Electrical Connections

The applicable ranges of robot and controller cables are shown in Table 4-15. Verify that you have compatible cables before beginning assembly.

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Table 4-15. Z-3 Type Cable Options

Cable Type	EXC, EXA Controller Cable	Adept MV Interface Cable
Z-Axis Robot Cable	90400-07**5	90400-07**5
Controller Cable (1 per axis)	90400-03003	
Interface Cable (1 per axis)		10400-070**

EXA and EXC Electrical Connections

1. Connect the X-axis cables:
   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-41. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “1-CN6 MOTOR 1” and “1-CN5 SENSOR 1”.
2. Connect the Z-axis cables:
   a. Connect the B holder end of the robot cable to the connectors of the Z-axis module (see Section 4.3 for holder mounting).
   b. Attach the A holder end of the robot cable to the motor end face of the X-axis module as shown in Figure 4-41 (refer to Section 4.3 for holder mounting).
   c. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).
   d. Connect the two barrel ends of the controller cable to the Z-axis robot cable holder on the X-axis module as shown in Figure 4-41. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.

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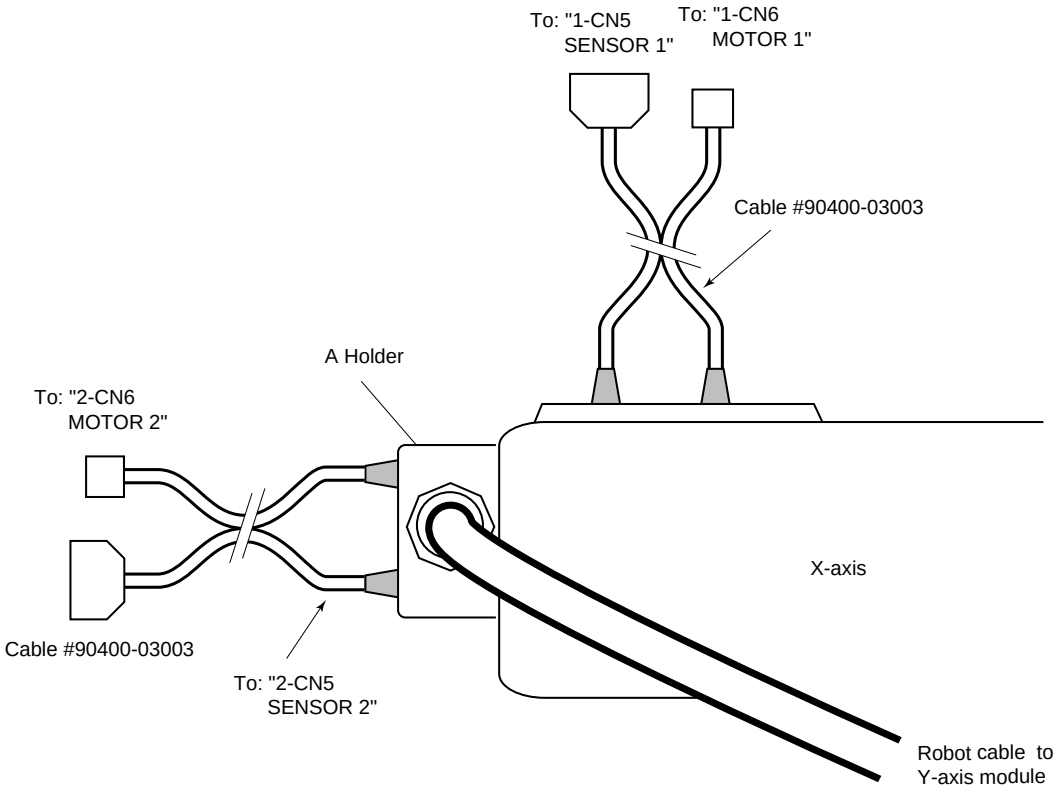


Figure 4-41. Connecting to an EXA or EXC Controller

Adept MV Controller Connections

1. Connect the X-axis cables:

   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-42. These connectors have different pin sizes and cannot be installed incorrectly.

   b. The D-sub connector connects to the Signal Interface Box connector marked "Axis 1". The final connector connects to the Axis 1 end of the B^+ Amp break-out cable.

2. Connect the Z-axis cables:

   a. Connect the B holder end of the robot cable to the motor end of the Z-axis module (see Section 4.3 for holder mounting).

   b. Attach the A holder end of the robot cable to the motor end face of the X-axis module as shown in Figure 4-42 (refer to Section 4.3 for holder mounting).

   c. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).

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d. Connect the two barrel ends of the controller cable to the Z-axis robot cable holder on the X-axis module as shown in Figure 4-42. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.

e. The D-sub connector connects to the Signal Interface Box connector marked “Axis 1”.

f. The final connector connects to the Axis 1 end of the B^+ Amp break-out cable (cable# 10400-00600).

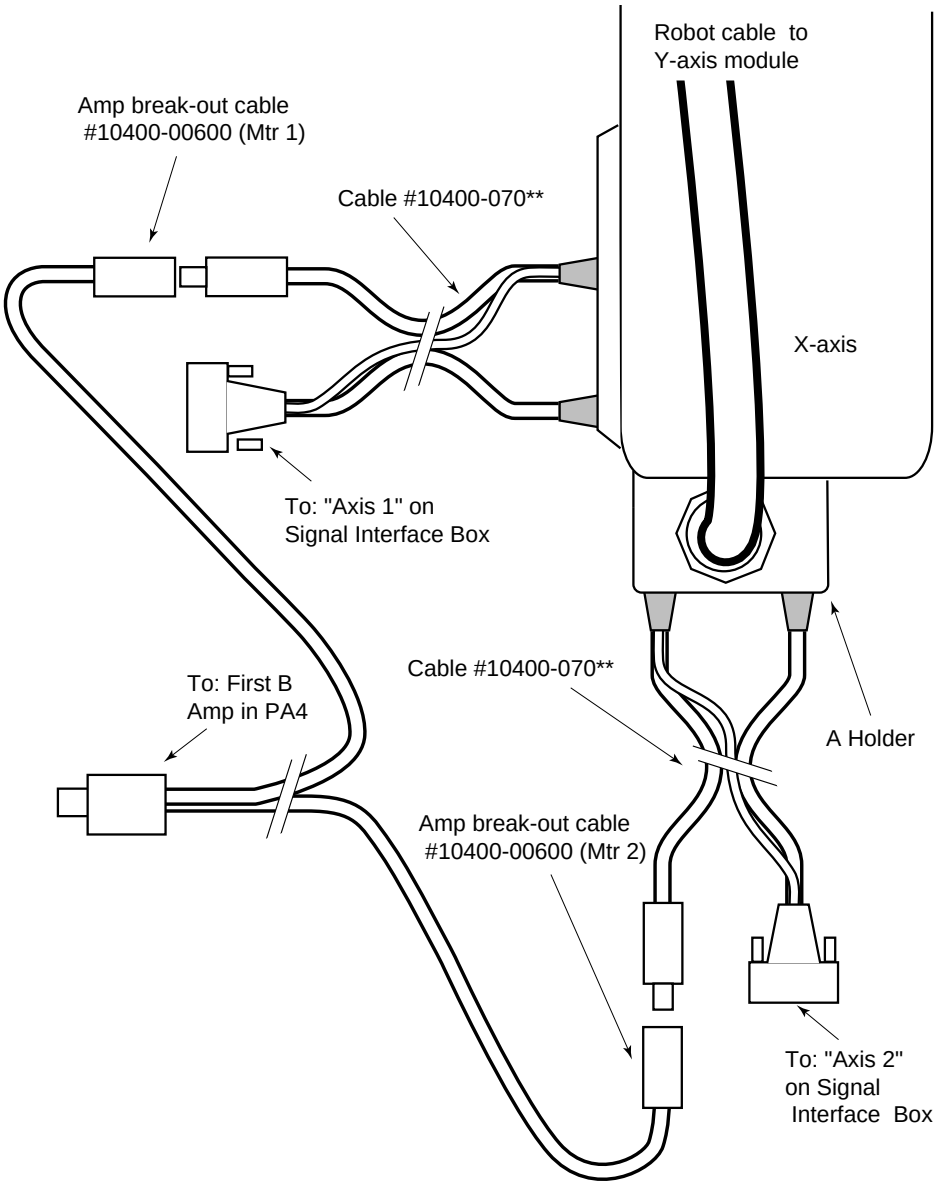


Figure 4-42. Connecting to an Adept MV Controller

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4.20 Z-4 Type Installation Procedure

The K-4 type combination connects an M module and an Sz module.

1. Insert the X-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm).
2. Insert the Z-axis chamfered and straight pins into the bracket and seat with a rubber mallet.
3. Carefully mate the combining bracket to the Z-axis. Do not secure with mounting bolts at this time.
4. Mate the Z-axis with combining bracket to the X-axis slider. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (refer to Table 3-3 for mounting bolt specifications).
5. Mount the Z-axis to combining bracket. Install the mounting bolts (see Figure 4-43 and refer to Table 3-3 for mounting bolt specifications).

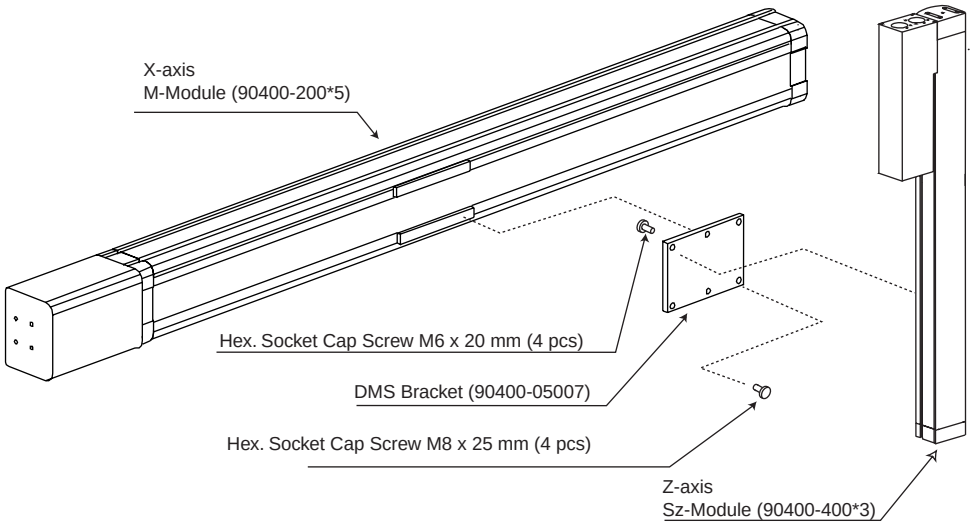


Figure 4-43. Z-4 Type Mechanical Assembly

Z-4 Type Electrical Connections

The applicable ranges of robot and controller cables are shown in Table 4-16. Verify that you have compatible cables before beginning assembly.

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Table 4-16. Z-4 Type Cable Options

Cable Type	EXC, EXA Controller Cable	Adept MV Interface Cable
Z-Axis Robot Cable	90400-07**5	90400-07**5
Controller Cable (1 per axis)	90400-03003	
Interface Cable (1 per axis)		10400-070**

EXA and EXC Electrical Connections

1. Connect the X-axis cables:
   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-44. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “1-CN6 MOTOR 1” and “1-CN5 SENSOR 1”.
2. Connect the Z-axis cables:
   a. Connect the B holder end of the robot cable to the connectors of the Z-axis module (see Section 4.3 for holder mounting).
   b. Attach the A holder end of the robot cable to the motor end face of the X-axis module as shown in Figure 4-44 (refer to Section 4.3 for holder mounting).
   c. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).
   d. Connect the two barrel ends of the controller cable to the Z-axis robot cable holder on the X-axis module as shown in Figure 4-44. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.

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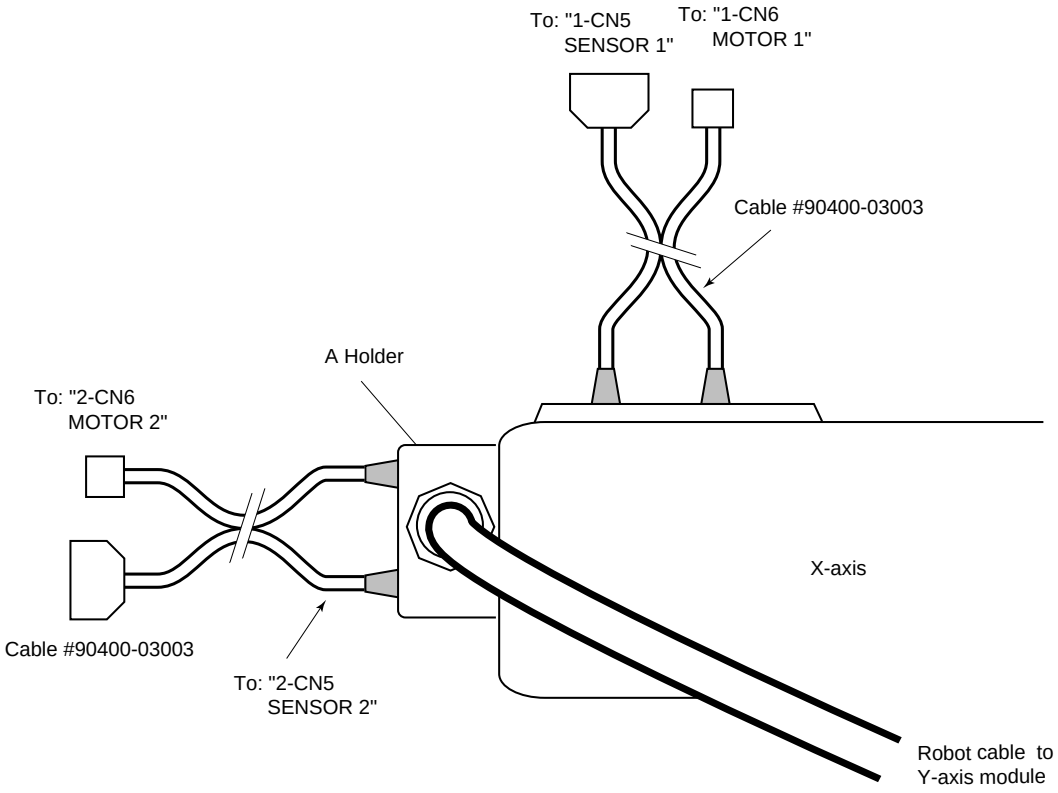


Figure 4-44. Connecting to an EXA or EXC Controller

Adept MV Controller Connections

1. Connect the X-axis cables:

   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-45. These connectors have different pin sizes and cannot be installed incorrectly.

   b. The D-sub connector connects to the Signal Interface Box connector marked "Axis 1". The final connector connects to the Axis 1 end of the B^+ Amp break-out cable.

2. Connect the Z-axis cables:

   a. Connect the B holder end of the robot cable to the motor end of the Z-axis module (see Section 4.3 for holder mounting).

   b. Attach the A holder end of the robot cable to the motor end face of the X-axis module as shown in Figure 4-45 (refer to Section 4.3 for holder mounting).

   c. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).

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d. Connect the two barrel ends of the controller cable to the Z-axis robot cable holder on the X-axis module as shown in Figure 4-45. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.

e. The D-sub connector connects to the Signal Interface Box connector marked “Axis 1”.

f. The final connector connects to the Axis 1 end of the B^+ Amp break-out cable (cable# 10400-00600).

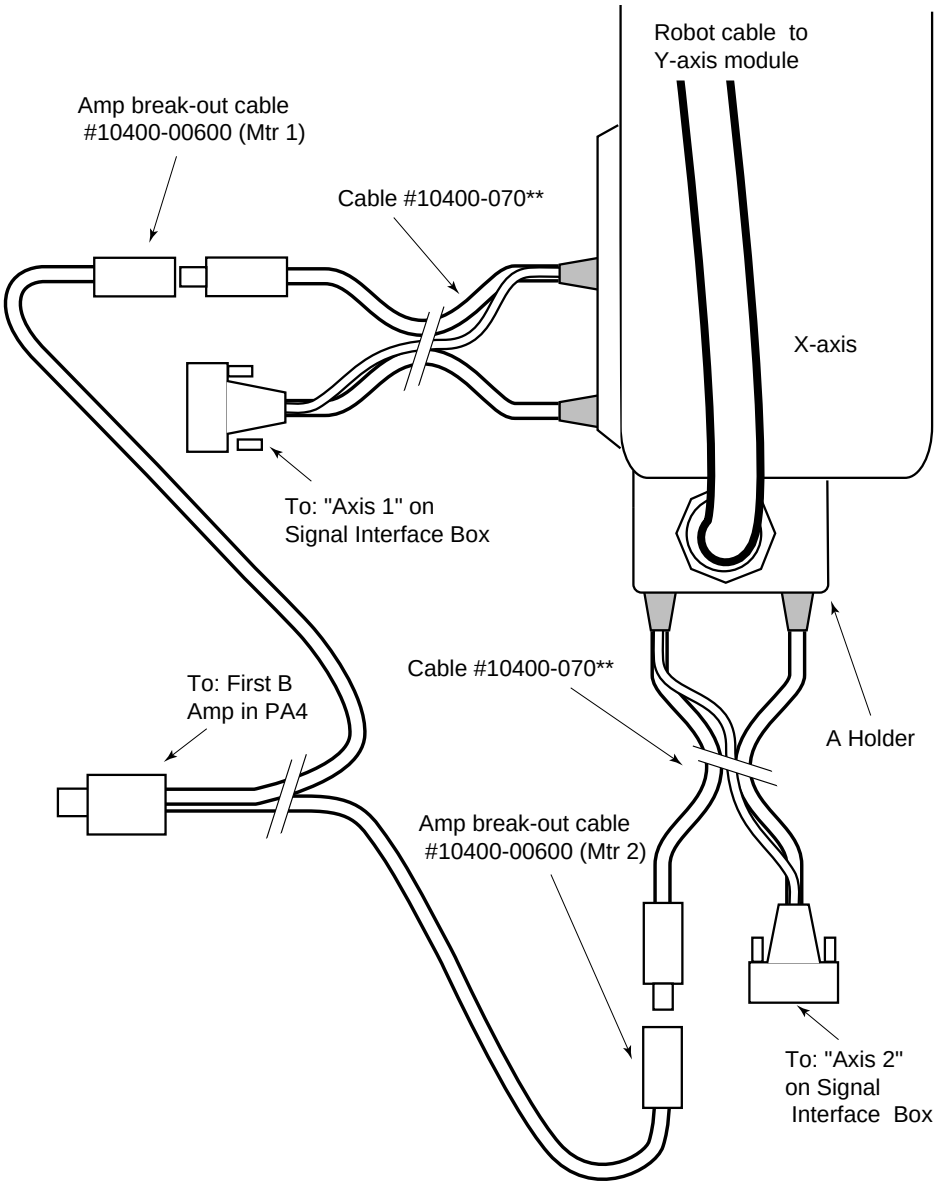


Figure 4-45. Connecting to an Adept MV Controller

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4.21 Assembling T-Type Combinations

In a T-type configuration the combining bracket mounts to the slider of the X-axis unit and to the Body of the Z-axis unit as shown in Figure 4-46.

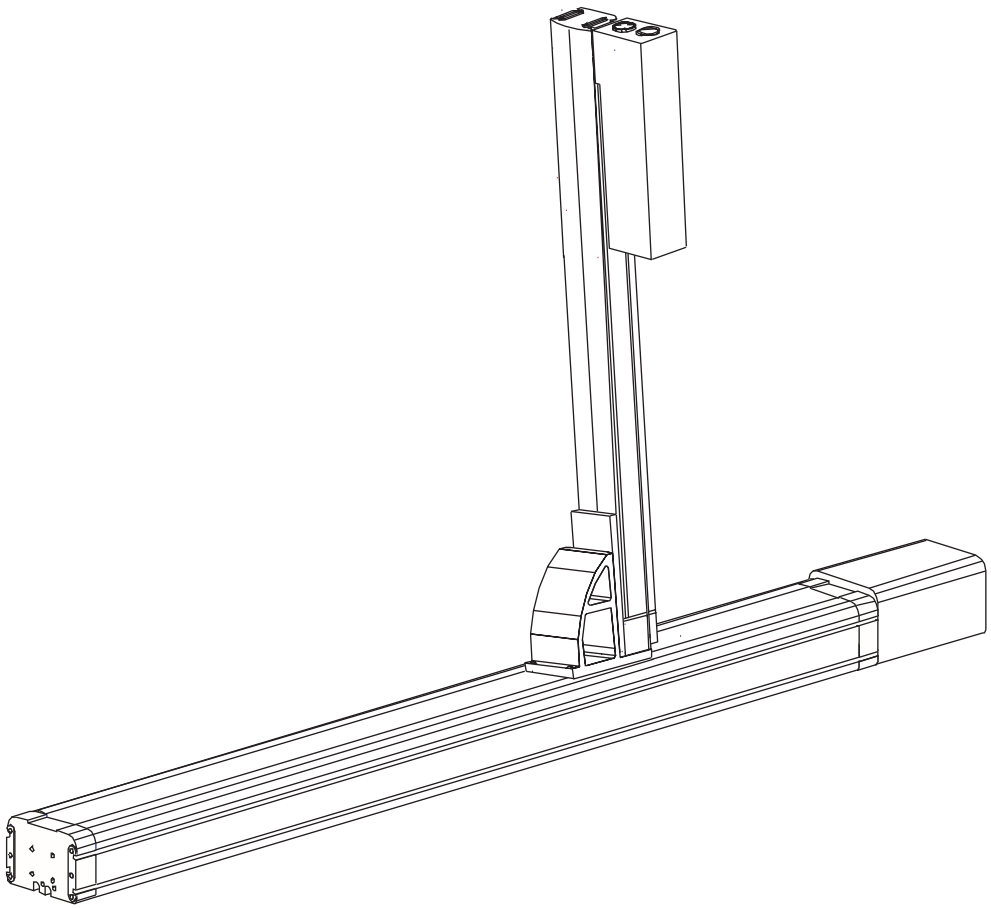


Figure 4-46. T-Type Combination

The applicable ranges of modules and their combining brackets are shown in Table 4-17. Verify that you have compatible X-axis, Z-axis, and combining bracket components before beginning assembly.

Table 4-17. T-Type Configuration Components.

Combination Type	X-Axis Module Type and Part Numbers		Z-Axis Module Type and Part Numbers		Combining Bracket Type and Part Number	
T	M	90400-20**5	Sz	90400-400*3	TMS	90400-05011

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4.22 T-Type Installation Procedure

The T-type connects a M module and a Sz modules.

1. Insert the X-axis chamfered and straight pins into the L-shaped bracket and seat with a rubber mallet (the pins must not project more than 8 mm).
2. Insert the Z-axis chamfered and straight pins into the L-shaped bracket and seat with a rubber mallet.
3. Mate the L-shaped combining bracket to the X-axis modules slider. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (refer to Table 3-3 for the mounting bolt specifications).
4. Mate the plate bracket to the mounting holes on the Z-axis counter motor side with mounting bolts (refer to Table 4-3 for the mounting bolt specifications).
5. Mount the Z-axis with plate bracket by aligning the pins on the L shaped combining bracket through the holes on the plate bracket. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (see Figure 4-47, and refer to Table 3-3 for the mounting bolt specifications).

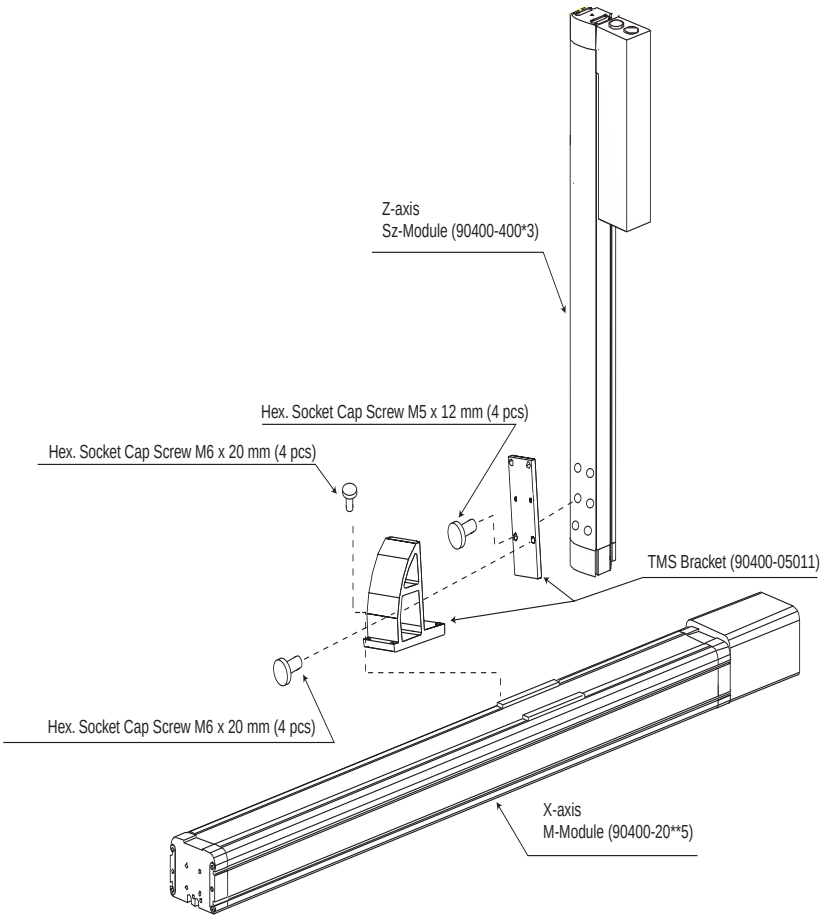


Figure 4-47. T-Type Mechanical Assembly

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T-Type Electrical Connections

The applicable ranges of robot and controller cables are shown in Table 4-18. Verify that you have compatible cables before beginning assembly.

Table 4-18. T-Type Cable Options

Cable Type	EXC, EXA Controller Cable	Adept MV Interface Cable
Z-Axis Robot Cable	90400-071*5	90400-071*5
Controller Cable (1 per axis)	90400-03003	
Interface Cable (1 per axis)		10400-070**

EXA and EXC Electrical Connections

1. Connect the X-axis cables:
   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-48. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “1-CN6 MOTOR 1” and “1-CN5 SENSOR 1”.
2. Connect the Z-axis cables:
   a. Connect the C holder end of the robot cable to the motor end of the Z-axis module (see Section 4.3 for holder mounting).
   b. Attach the A holder end of the robot cable to the mounting holes on the motor cover of the X-axis module as shown in Figure 4-48 (refer to Section 4.3 for holder mounting).
   c. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).
   d. Connect the two barrel ends of the cable to the Z-axis module as shown in Figure 4-48. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.

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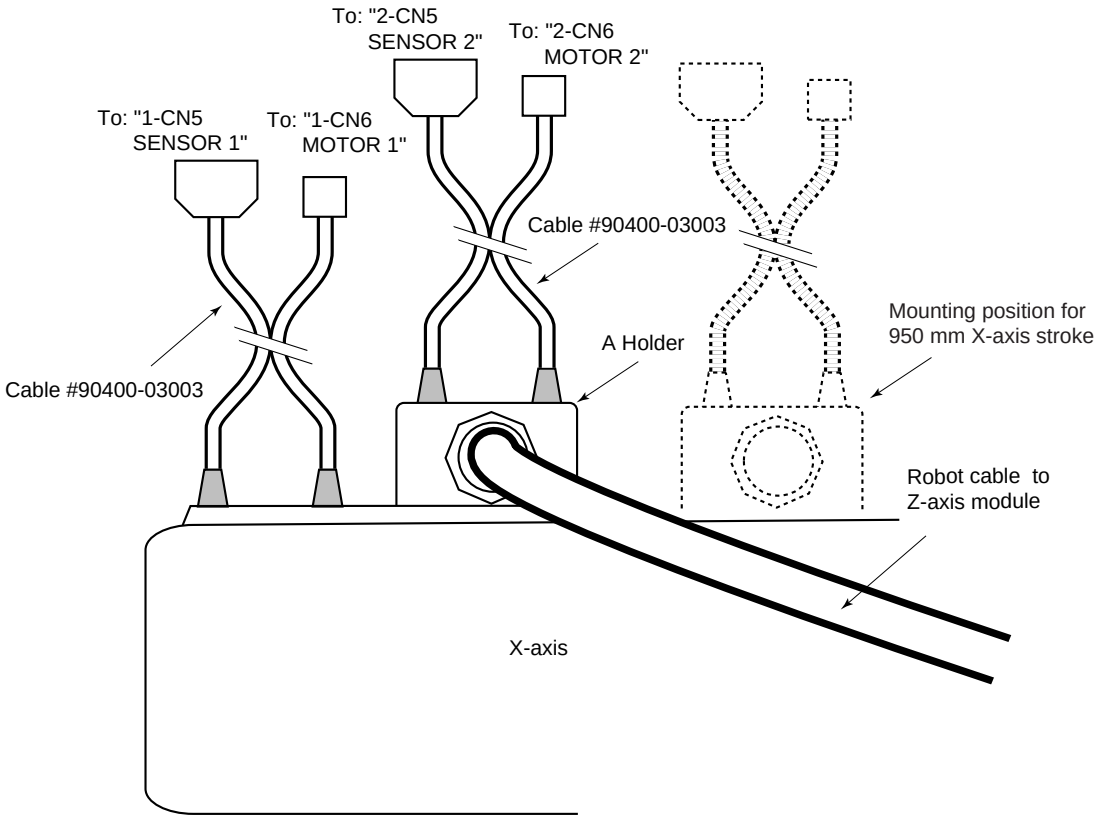


Figure 4-48. Connecting to an EXA or EXC Controller

Adept MV Controller Connections

1. Connect the X-axis cables:
   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-49. These connectors have different pins sizes and cannot be installed incorrectly.
   b. The D-sub connector connects to the Signal Interface Box connector marked "Axis 1". The final connector connects to the Axis 1 end of the B^+ Amp break-out cable.
2. Connect the Z-axis cables:
   a. Connect the C holder end of the robot cable to the motor end of the Z-axis module (see Section 4.3 for holder mounting).
   b. Attach the A holder end of the robot cable to the mounting holes on the motor cover of the X-axis module as shown in Figure 4-49 (refer to Section 4.3 for holder mounting).
   c. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).

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d. Connect the two barrel ends of the cable to the A holder as shown in Figure 4-49. These connectors have different pin sizes and cannot be installed incorrectly.

e. The D-sub connector connects to the Signal Interface Box connector marked “Axis 2”.

f. The final connector connects to the Axis 1 end of the B^+ Amp break-out cable (cable# 10400-00600).

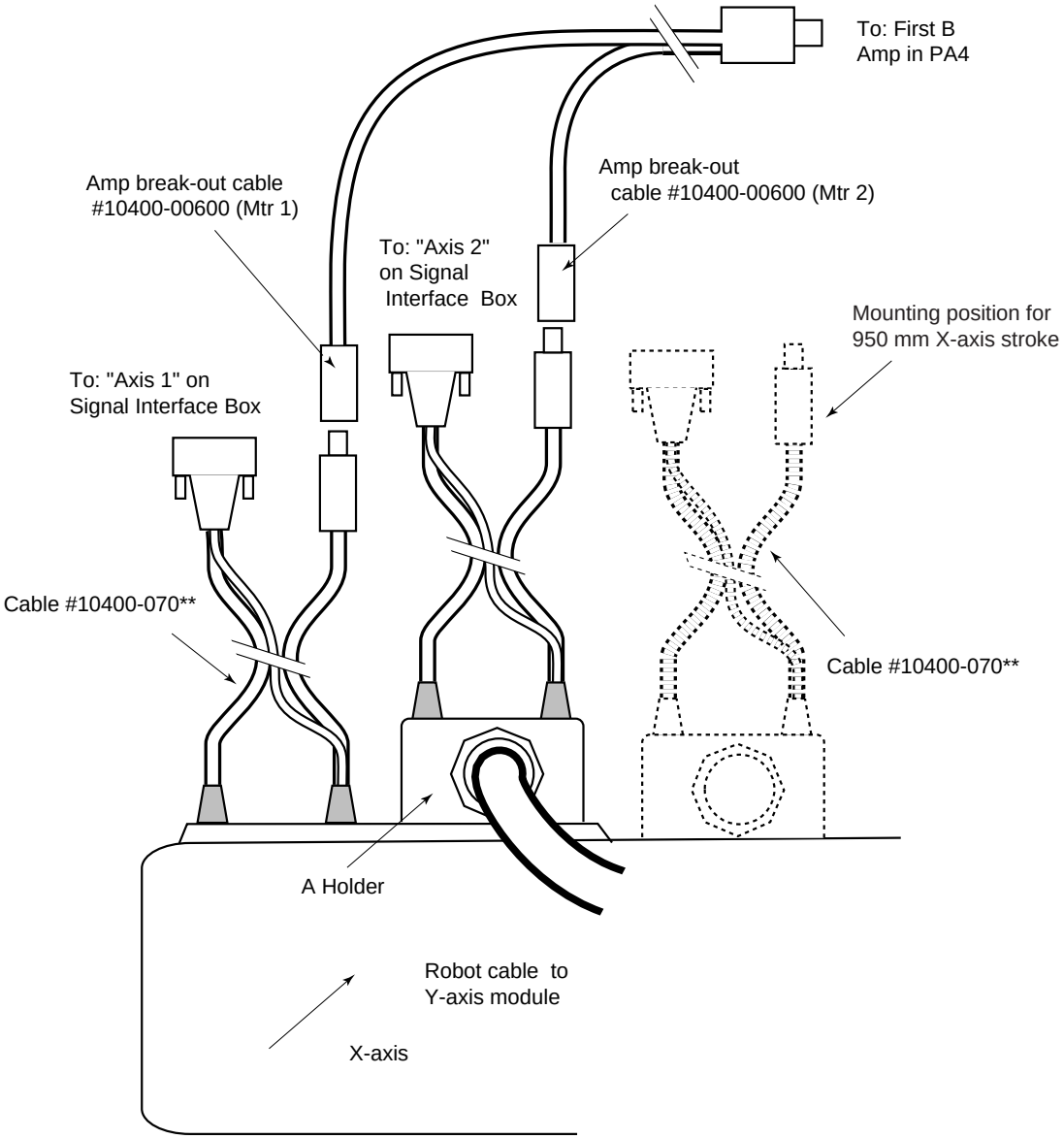


Figure 4-49. Connecting to an Adept MV Controller

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4.23 Assembling X-Type Combinations

In a X-type configuration the combining bracket mounts to the slider of the X-axis unit and to the slider of the Y-axis unit as shown in Figure 4-50.

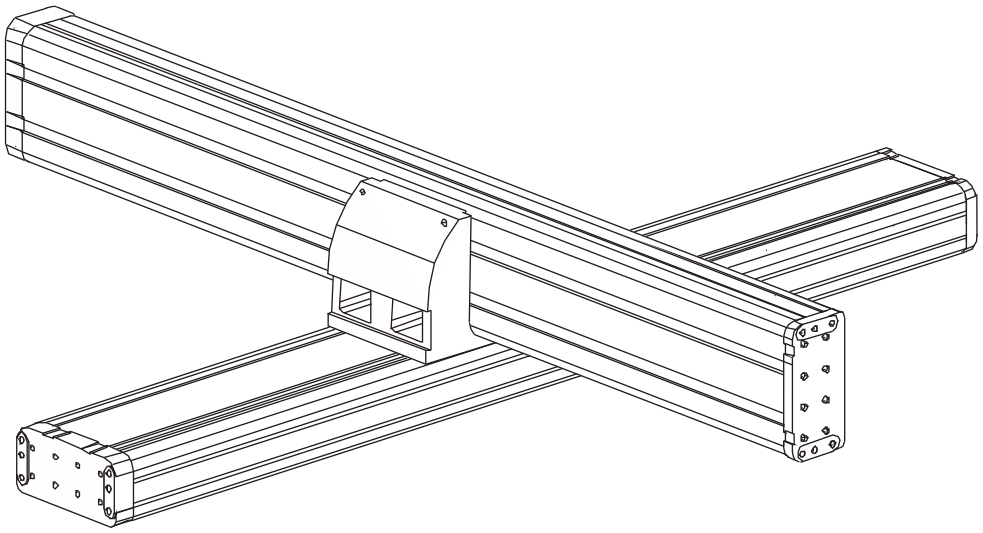


Figure 4-50. X-Type Combination

The applicable range of modules and their combining brackets is shown in Table 4-19. Verify that you have compatible X-axis, Y-axis, and combining bracket components before beginning assembly.

Table 4-19. X-Type Configuration Componets.

Combination Type	X-Axis Module Type and Part Numbers		Y-Axis Module Type and Part Numbers		Combining Bracket Type and Part Number	
X-1	H	90400-10**0	H	90400-100*0	XHH	90400-05008
X-2	H	90400-100*0	M	90400-200*5	XHM	90400-05009
X-3	M	90400-200*5	M	90400-200*5	XMM	90400-05010
X-1 Extended Stroke	H	90400-11**0	H	90400-11**0	XHH	90400-05008
X-2 Extended Stroke	H	90400-11**0	M	90400-211*5	XHM	90400-05009

NOTE: Gantry modules (pt# 90400-041**) are recommended by Adept when stroke lengths exceed 950 mm in the Y-axis.

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4.24 X-1 Type Installation Procedure

1. Insert the X-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm).
2. Insert the Y-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm).
3. Mate the combining bracket to the X-axis slider. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (refer to Table 3-3 for the mounting bolt specifications).
4. Mate the Y-axis to combining bracket by aligning the pin holes on the Y-axis module slider to the pins on the side of the bracket. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (see Figure 4-51, and refer to Table 3-3 for the mounting bolt specifications).

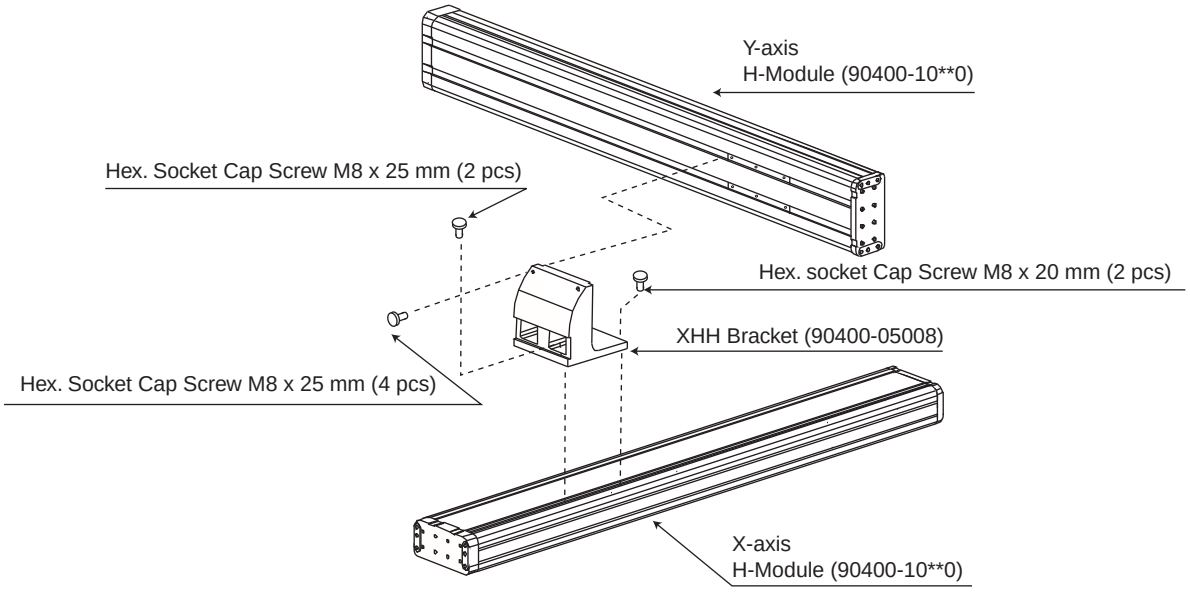


Figure 4-51. X-1 Type Mechanical Assembly

X-1 Type Electrical Connections

The applicable ranges of robot and controller cables are shown in Table 4-20. Verify that you have compatible cables before beginning assembly.

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Table 4-20. X-1 Type Cable Options

Cable Type	EXC, EXA Controller Cable	Adept MV Interface Cable
Y-Axis Robot Cable	90400-071*5	90400-071*5
Controller Cable (1 per axis)	90400-03003	
Interface Cable (1 per axis)		10400-070**
Cable track assembly for Extended stroke models	90400-08009	

NOTE: Adept recommends using cable tracks for extended stroke configurations. See Section 4.3 for cable track installation.

EXA and EXC Electrical Connections

1. Connect the X-axis cables:
   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-52. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “1-CN6 MOTOR 1” and “1-CN5 SENSOR 1”.
2. Connect the Y-axis cables:
   a. Connect the C holder end of the robot cable to the motor end of the Y-axis H module (see Section 4.3 for holder mounting).
   b. Attach the A holder end of the robot cable to the side of the X-axis H module as shown in Figure 4-52 (refer to Section 4.3 for holder mounting).
   c. Connect the two barrel ends of the cable to the Y-axis module as shown in Figure 4-52. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.

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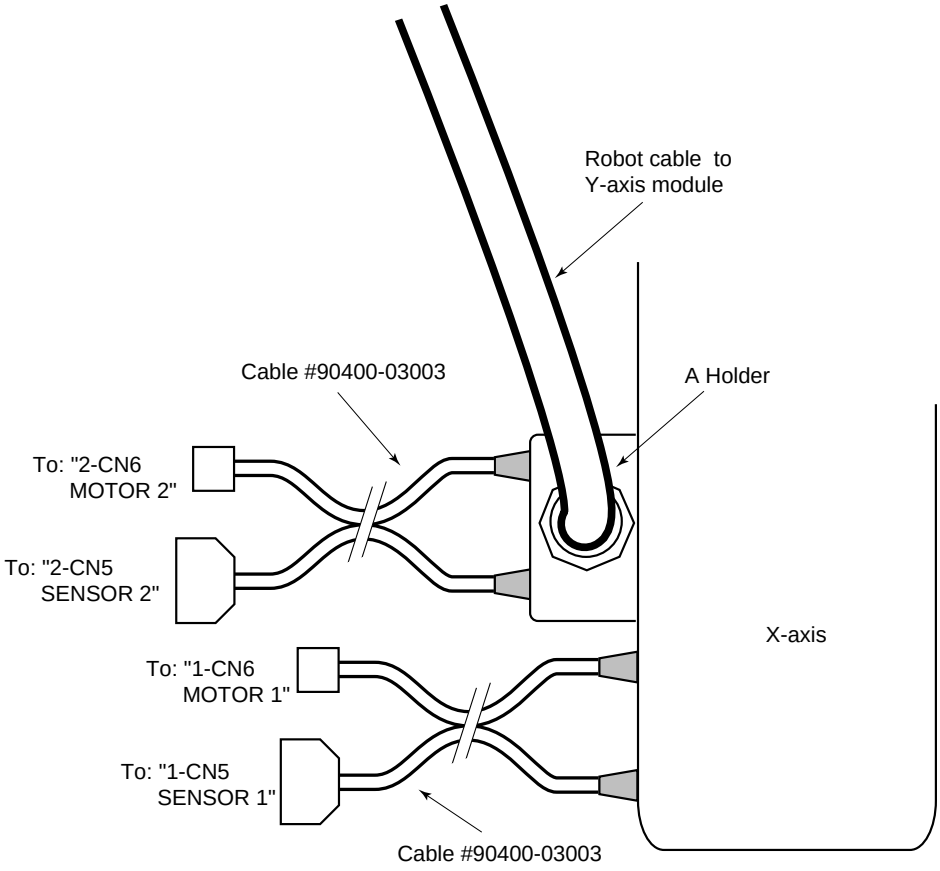


Figure 4-52. Connecting to an EXA or EXC Controller

Adept MV Controller Connections

1. Connect the X-axis cables:

   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-53. These connectors have different pin sizes and cannot be installed incorrectly.

   b. The D-sub connector connects to the Signal Interface Box connector marked "Axis 1". The final connector connects to the Axis 1 end of the B^+ Amp break-out cable.

2. Connect the Y-axis cables:

   a. Connect the C holder end of the robot cable to the motor end of the Y-axis H module (see Section 4.3 for holder mounting).

   b. Attach the A holder end of the robot cable to the side of the X-axis H module as shown in Figure 4-53 (refer to Section 4.3 for holder mounting).

   c. Connect the two barrel ends of the cable to the A holder as shown in Figure 4-53. These connectors have different pin sizes and cannot be installed incorrectly.

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d. The D-sub connector connects to the Signal Interface Box connector marked "Axis 2".

e. The final connector connects to the Axis 1 end of the B^+ Amp break-out cable (cable# 10400-00600).

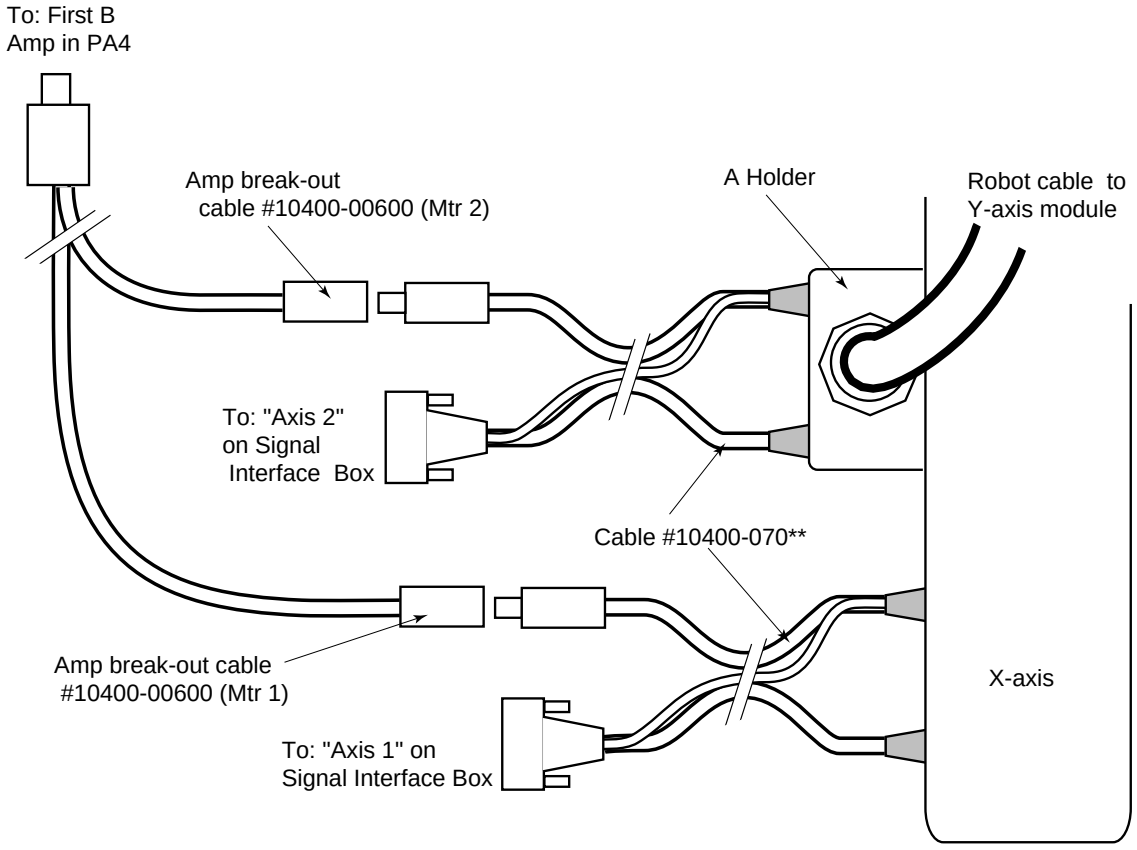


Figure 4-53. Connecting to an Adept MV Controller

4.25 X-2 Type Installation Procedure

1. Insert the X-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm).
2. Insert the Y-axis chamfered and straight pins into the bracket and seat with a rubber mallet.
3. Mate the combining bracket to the X-axis slider. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts.
4. Mate the Y-axis to combining bracket by aligning the motor-side pin holes on the Y-axis module to the pins on the side of the bracket (these holes are on the side opposite the sliders). Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (see Figure 4-54).

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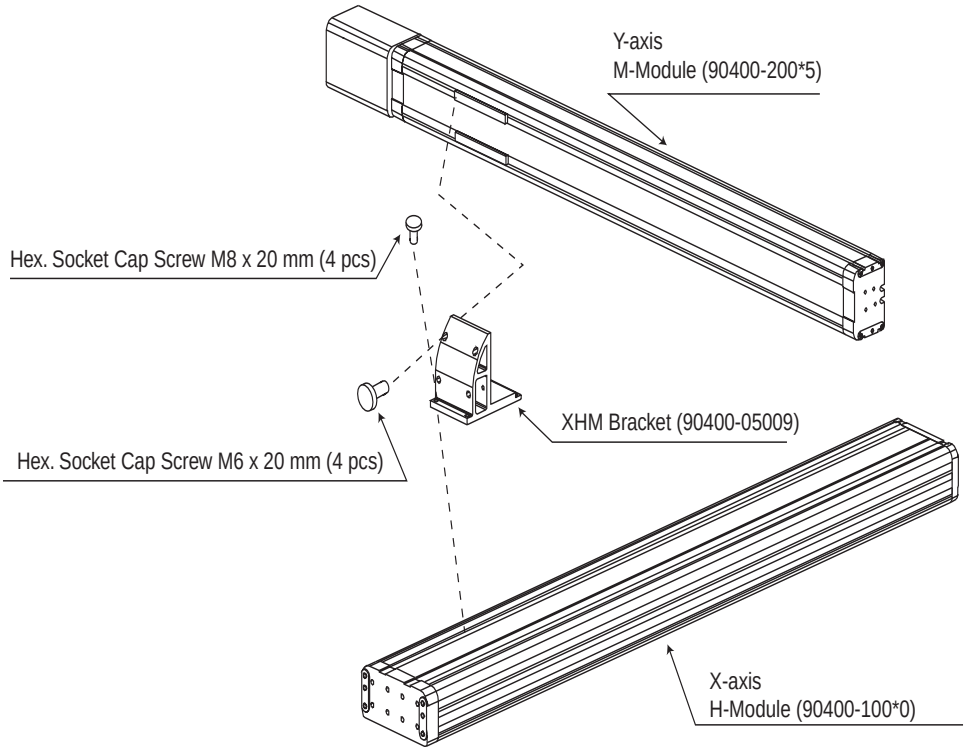


Figure 4-54. X-2 Type Mechanical Assembly

X-2 Type Electrical Connections

The applicable ranges of robot and controller cables are shown in Table 4-21. Verify that you have compatible cables before beginning assembly.

Table 4-21. X-2 Type Cable Options

Cable Type	EXC, EXA Controller Cable	Adept MV Interface Cable
Y-Axis Robot Cable	90400-07**5	90400-07**5
Controller Cable (1 per axis)	90400-03003	
Interface Cable (1 per axis)		10400-070**
Cable track assembly for Extended stroke models	90400-08010	

NOTE: Adept recommends using cable tracks for extended stroke configurations. See Section 4.3 for cable track installation.

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EXA and EXC Electrical Connections

1. Connect the X-axis cables:

   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-55. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “1-CN6 MOTOR 1” and “1-CN5 SENSOR 1”.

2. Connect the Y-axis cables:

   b. Connect the C holder end of the robot cable to the motor end of the Y-axis M module (see Section 4.3 for holder mounting).

   c. Attach the A holder end of the robot cable to the side of the X-axis H module as shown in Figure 4-55 (refer to Section 4.3 for holder mounting).

   d. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) of the A holder and twist the cable to the upright position. Retighten the cap nut. and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).

   e. Connect the two barrel ends of the cable to the Y-axis module as shown in Figure 4-55. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.

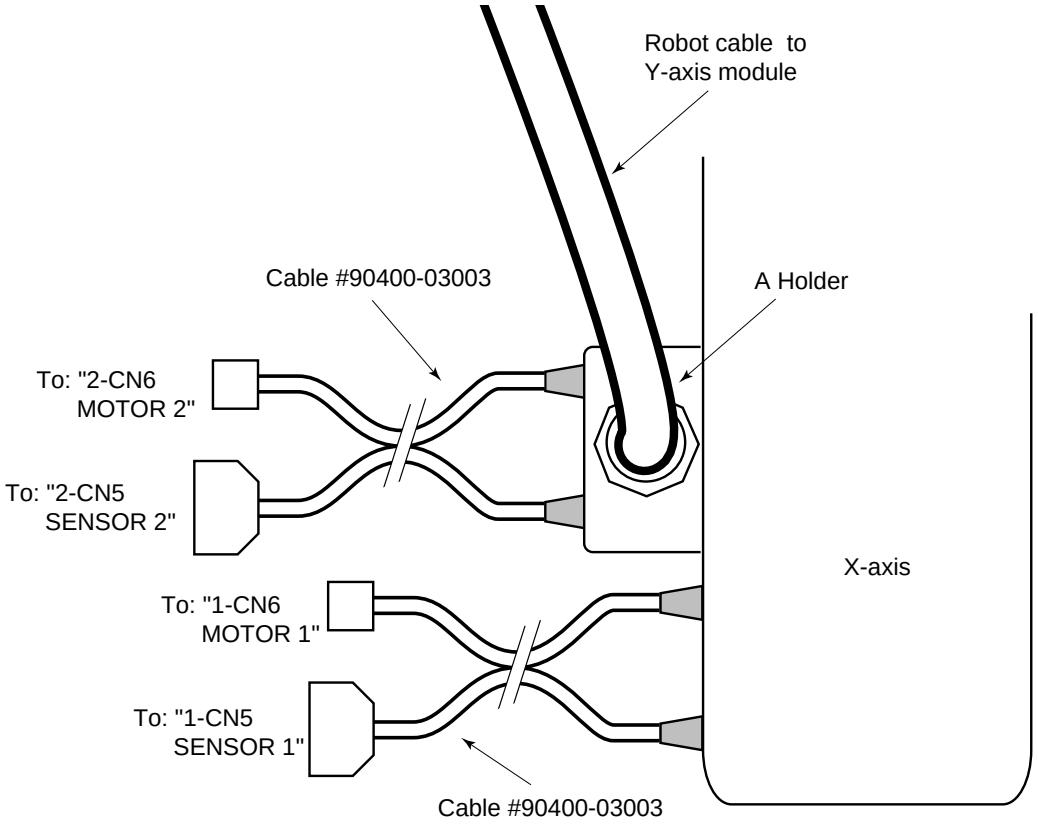


Figure 4-55. Connecting to an EXA or EXC Controller

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Adept MV Controller Connections

1. Connect the X-axis cables:

   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-56. These connectors have different pin sizes and cannot be installed incorrectly.

   b. The D-sub connector connects to the Signal Interface Box connector marked “Axis 1”. The final connector connects to the Axis 1 end of the B^+ Amp break-out cable.

2. Connect the Y-axis cables:

   c. Connect the C holder end of the robot cable to the motor end of the Y-axis M module (refer to Section 4.3 for holder rotation and mounting).

   d. Attach the A holder end of the robot cable to the side of the X-axis module as shown in Figure 4-56 (refer to Section 4.3 for holder rotation and mounting).

   e. Move the X-axis to the center of it movement stroke. Loosen the cap nut (see Figure 4-1) of the A holder and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).

   f. Connect the two barrel ends of the cable to the A holder as shown in Figure 4-56. These connectors have different pin sizes and cannot be installed incorrectly.

   g. The D-sub connector connects to the Signal Interface Box connector marked “Axis 2”.

   h. The final connector connects to the Axis 1 end of the B^+ Amp break-out cable (cable# 10400-00600).

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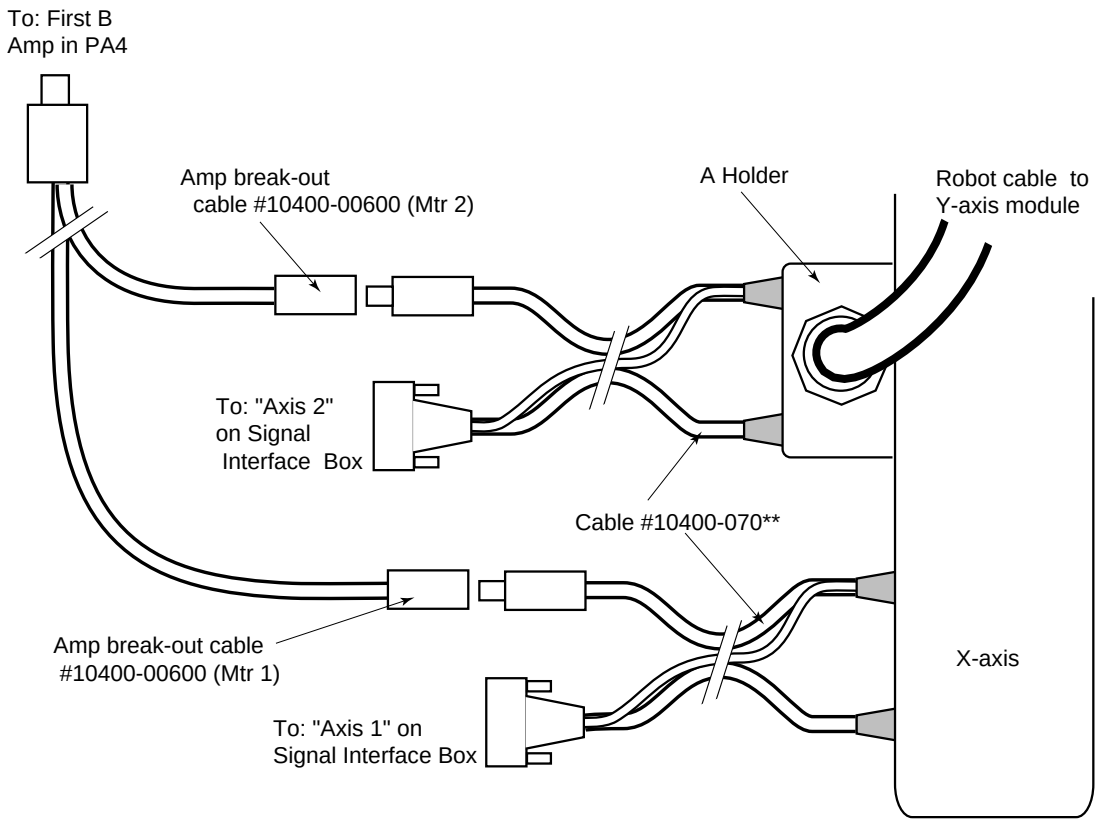


Figure 4-56. Connecting to an Adept MV Controller

4.26 X1 and X2 Extended Stroke Cable Track Installation

When using extended stroke modules and certain other configurations, Adept recommends the use of cable tracks.

Follow these directions to install cable tracks (see Figure 4-18).

1. Slide the module rail keys into the X-axis. The cable track supports mount to these keys.
2. Mount the cable track supports using M3 x 6 screws. Start with the cable track support away from the motor side of the module and torque to 1.47 N • m (13.0 in • lb).
3. Mount the remaining cable track supports and cable track support bracket (nonmoving side) to the X-axis in the same manner as steps 1 and 2.

   NOTE: In some configurations the cable track supports must be mounted to the systems base vice the X-axis. In this case Drill M6-25.4 mm tapped holes and mount supports to the base with M6 screws, 10mm long, and tighten to 1.47 N • m (13.0 lb • in).

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4. Mount the cable track support bracket (moving side) with M4-6 screws to the axis combining bracket and tighten to 2.9 N • m (25.6 in • lb).
5. Mount the holder mounting plate to the X-axis cover plate with M5-6 screws and torque to 5.9 N • m (52.2 in • lb).
6. Position the cable track along the X-axis cable track supports with the cable support fixture on the cable track support bracket (non-moving side).
7. Using 4 nuts, mount the cable support fixture to the cable track support bracket (non-moving side) and tighten to 1.47 N • m (13.0 in • lb).
8. Mount the other support fixture of the cable track to the cable track support bracket (moving side) with 4 screws and tapped securing plate. Place the securing plate is placed under the cable track support bracket andtighten to 1.47 N • m (13.0 in • lb).

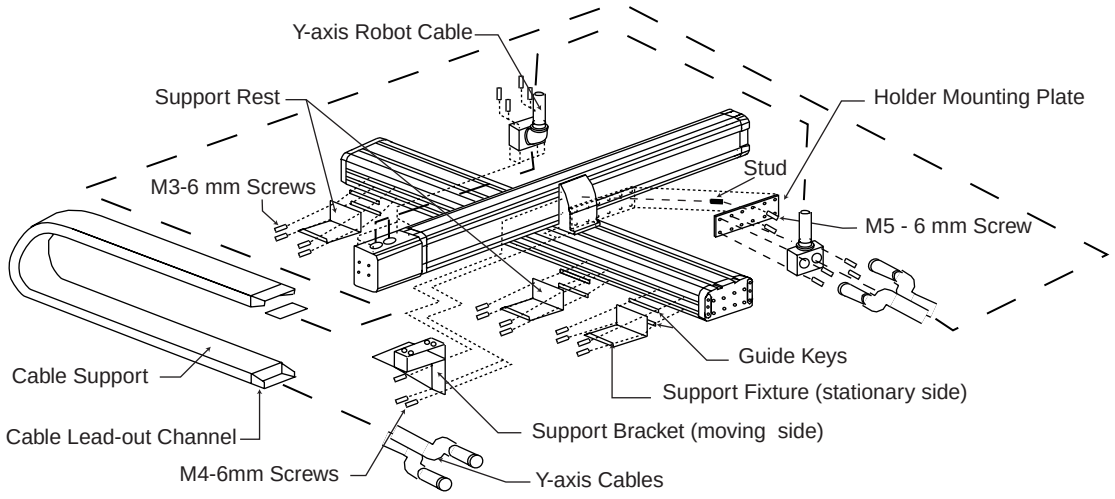


Figure 4-57. Cable Tracks

9. Mount the C-holder (elbow side) of the robot cable to the Y-axis connectors and the A-holder (straight side) to the holder mounting plate (step 5) with M3-57 screws and torque to 1.47 N • m (13.0 in • lb).

   NOTE: Cable holders will have to be rotated so that the cable stands upright. Refer to page 64 for directions on changing the angle of the cable holders.

10. Connect all cable connectors to the controller and axis as described in the above electrical connection procedures.

    NOTE: Adept recommends labeling the cables, with the enclosed lables, on the connectors to avoid misconnection and damage to the AdeptModules system.

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Adding User Cables to the Cable Track

When adding user cables to the cable tracks open the top of the cable track using a standard screw driver (see Figure 4-58). Be aware of the cross-sectional area of the cable track for the amount of space for user cables and air hoses.

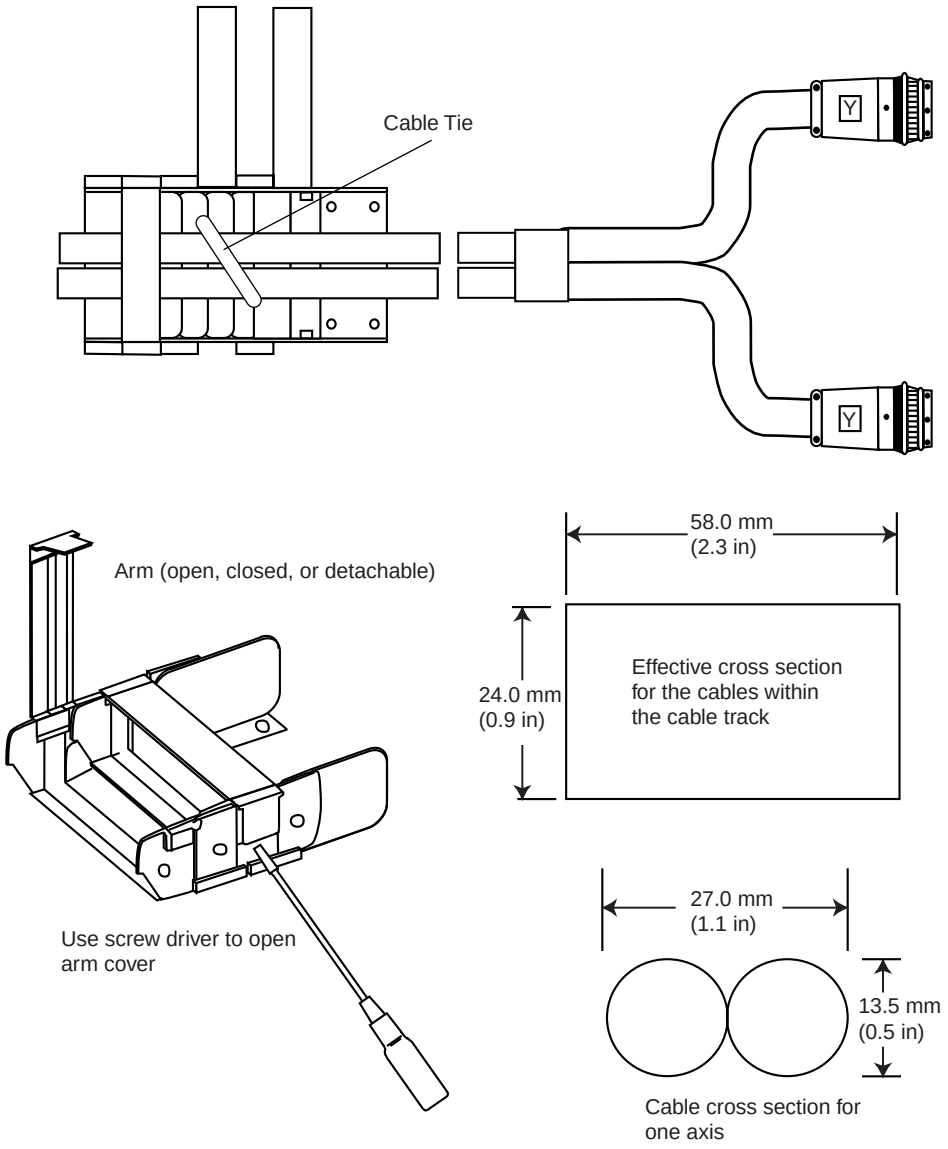


Figure 4-58. Cable Track User Cable Installation

4.27 X-3 Type Installation Procedure

1. Insert the X-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm).

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2. Insert the Y-axis chamfered and straight pins into the bracket and seat with a rubber mallet.
3. Mate the combining bracket to the X-axis slider. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (refer to Table 3-3 for mounting bolt specifications).
4. Mate the Y-axis to combining bracket by aligning the motor-side pin holes on the Y-axis module to the pins on the side of the bracket (these holes are on the side opposite the sliders). Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (see Figure 4-59).

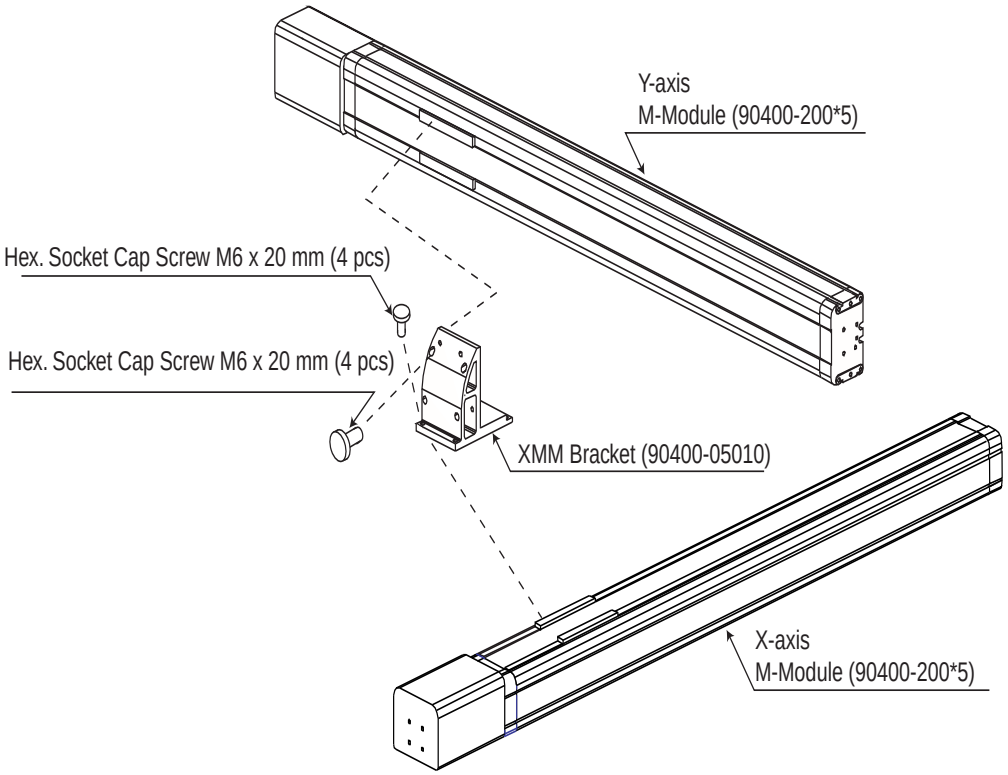


Figure 4-59. X-3 Type Mechanical Assembly

X-3 Type Electrical Connections

The applicable ranges of robot and controller cables are shown in Table 4-22. Verify that you have compatible cables before beginning assembly.

Table 4-22. X-3 Type Cable Options

Cable Type	EXC, EXA Controller Cable	Adept MV Interface Cable
Y-Axis Robot Cable	90400-07**5	90400-07**5

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Table 4-22. X-3 Type Cable Options (Continued)

Cable Type	EXC, EXA Controller Cable	Adept MV Interface Cable
Controller Cable (1 per axis)	90400-03003	
Interface Cable (1 per axis)		10400-070**

EXA and EXC Electrical Connections

1. Connect the X-axis cables:
   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-60. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “1-CN6 MOTOR 1” and “1-CN5 SENSOR 1”.
2. Connect the Y-axis cables:
   a. Rotate the C holder 90 degrees (refer to Section 4.3 for holder rotation).
   b. Connect the C holder end of the robot cable to the motor end of the S module (refer Section 4.3 for holder mounting).
   c. Attach the A holder end of the robot cable to the side of the M module as shown in Figure 4-60 (refer to Section 4.3 for holder mounting).
   d. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).
   e. Connect the two barrel ends of the cable to the Y-axis module as shown in Figure 4-60. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.

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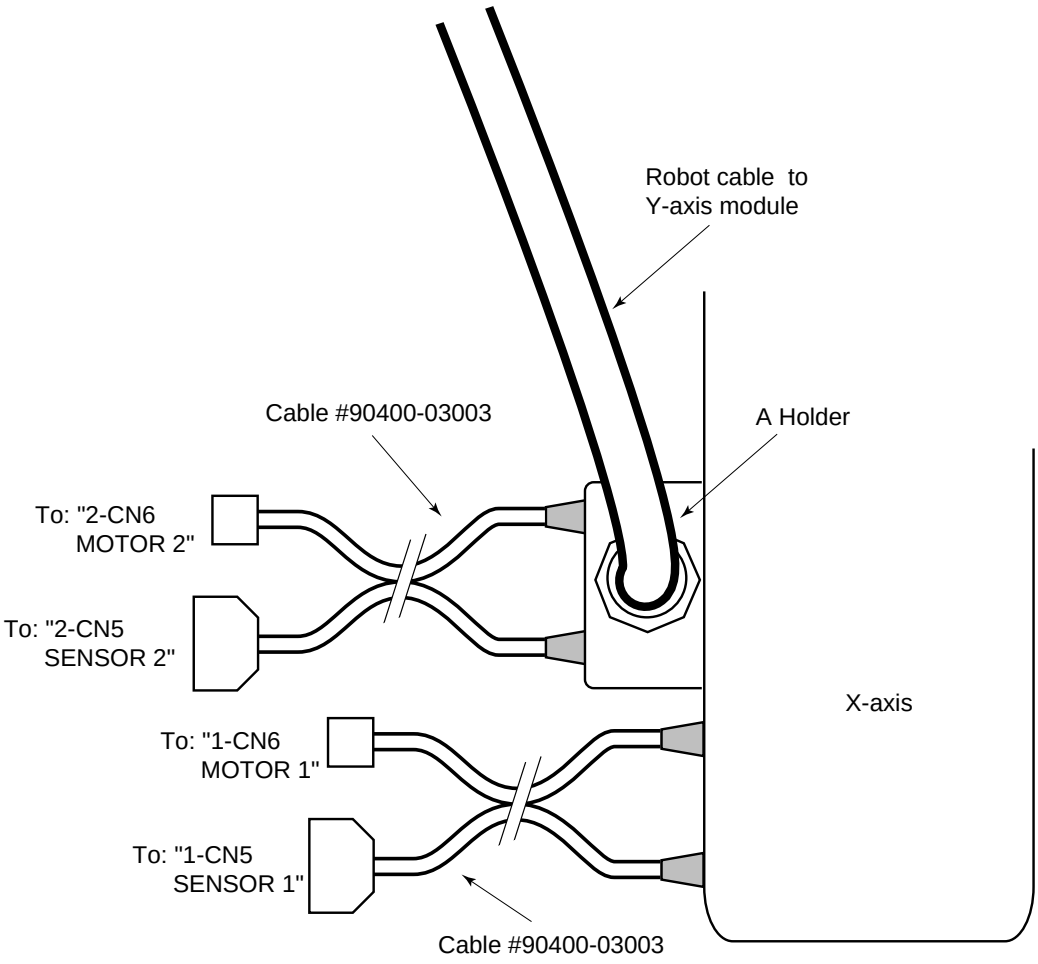


Figure 4-60. Connecting to an EXA or EXC Controller

Adept MV Controller Connections

1. Connect the X-axis cables:
   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 4-61. These connectors have different pin sizes and cannot be installed incorrectly.
   b. The D-sub connector connects to the Signal Interface Box connector marked "Axis 1". The final connector connects to the Axis 1 end of the B^+ Amp break-out cable.
2. Connect the Y-axis cables:
   a. Rotate the C holder 90 degrees (refer to Section 4.3 for holder rotation).
   b. Connect the C holder end of the robot cable to the motor end of the Y-axis module (refer to Section 4.3 for holder rotation and mounting).
   c. Attach the A holder end of the robot cable to the side of the X-axis module as shown in Figure 4-61 (refer to Section 4.3 for holder rotation and mounting).

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d. Move the X-axis to the center of its movement stroke. Loosen the cap nut (see Figure 4-1) and twist the cable to the upright position. Retighten the cap nut and torque to 7.5 to 9.0 N • m (66.4 to 79.6 in • lb).

e. Connect the two barrel ends of the cable to the A holder as shown in Figure 4-61. These connectors have different pin sizes and cannot be installed incorrectly.

f. The D-sub connector connects to the Signal Interface Box connector marked "Axis 1".

g. The final connector connects to the Axis 1 end of the B^+ Amp break-out cable (cable# 10400-00600).

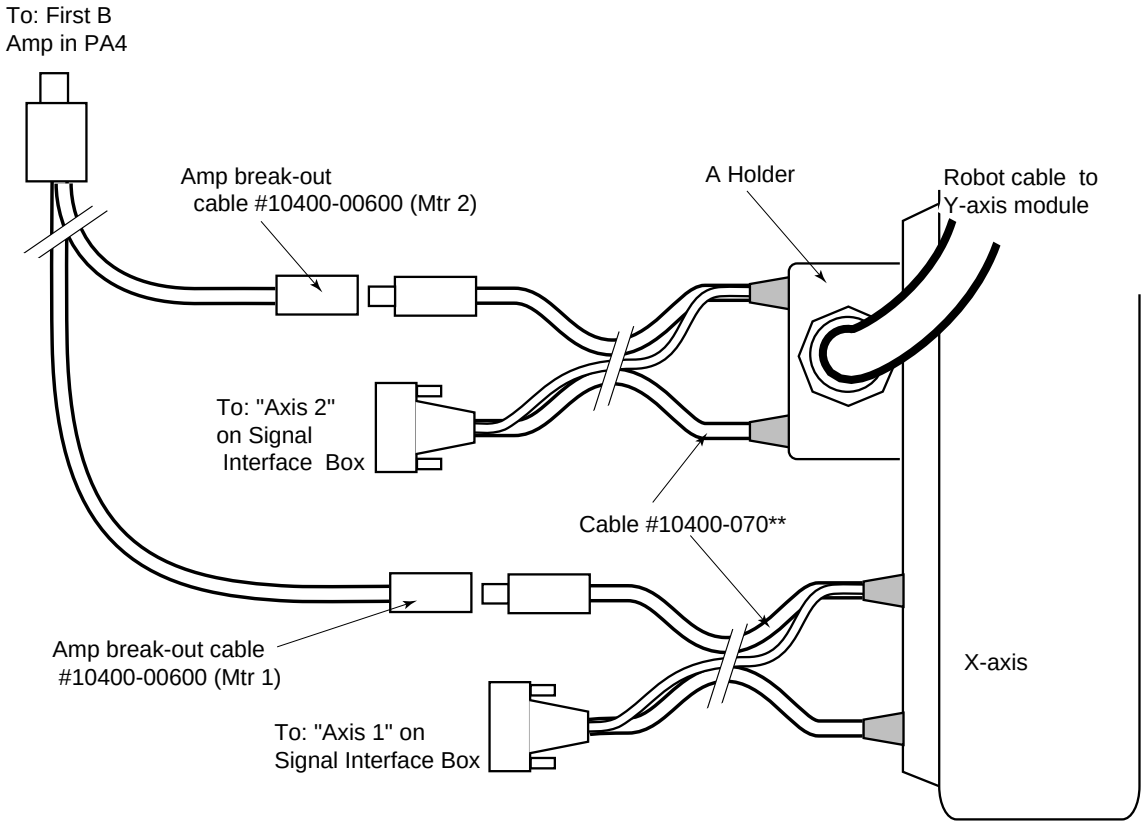


Figure 4-61. Connecting to an Adept MV Controller

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Mechanical Installation, Adding Axis Three

5

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5.1 Introduction

The robot modules are easily combined into a three-axis system using optional combining brackets.

This section describes the tasks required to configure a three-axis system in addition to gantry support installation. Refer to the section applicable for the specific combination types should a three or four axis configuration be required.

> **NOTE:** To mount brackets, the screw holes shown in Chapter 8 should be used. Do not use other screw holes for this purpose.

Figure 5-1 depicts a typical three-axis configuration.

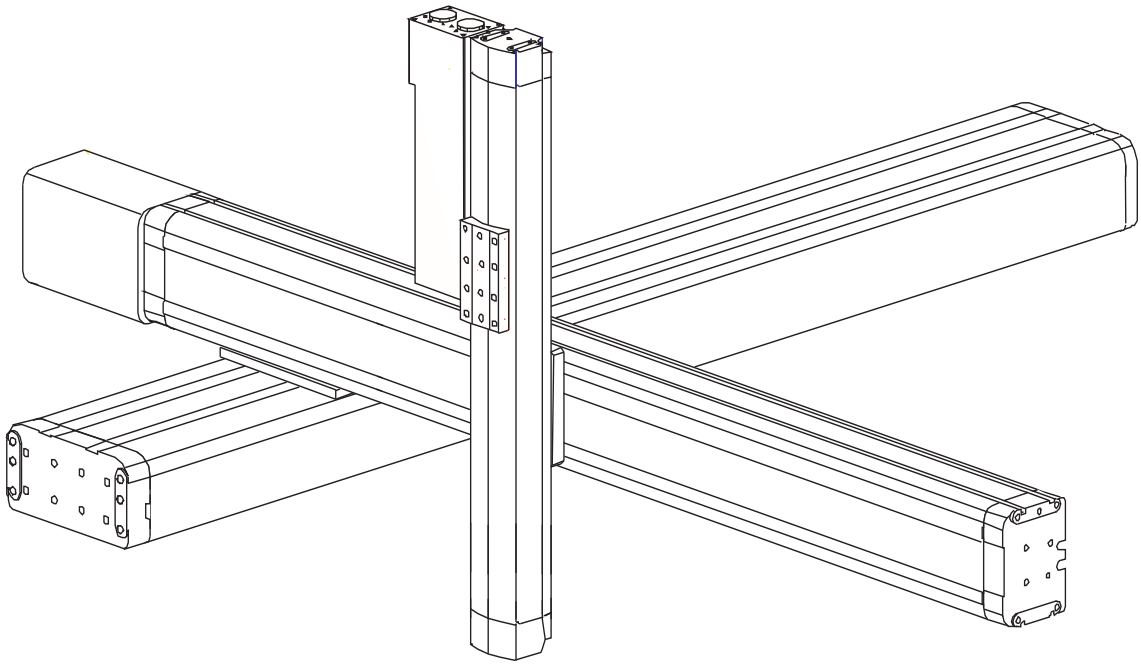


Figure 5-1. Typical Three-Axis Configuration

> **NOTE:** When using long stroke combinations, a cable support and gantry module unit is recommended by Adept.

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5.2 Assembling P-Type Combinations

In a P-type configuration the combining bracket mounts to the slider of the X- and Y-axis unit, and to the body or slider of the Z-axis unit. A Z-axis slider stroke is shown in Figure 5-2.

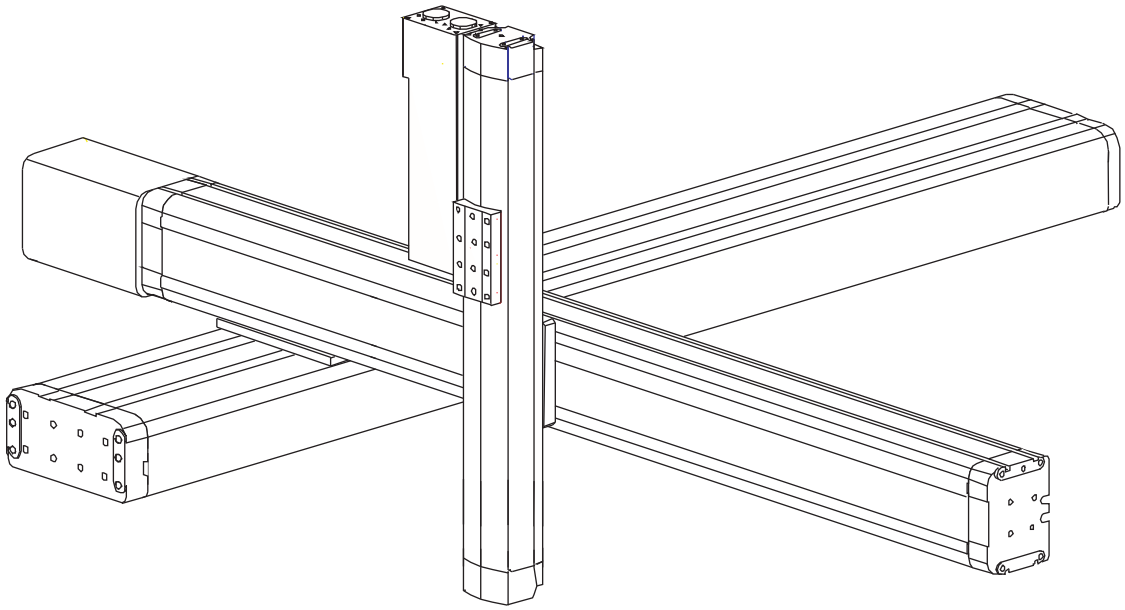


Figure 5-2. P-Type Combination with Z-axis Slider Stroke

The applicable ranges of modules and their combining brackets are shown in Table 5-1 and Table 5-2. Verify that you have compatible X-axis, Y-axis, Z-axis, and combining bracket components before beginning assembly.

Table 5-1. P-Type Configuration X- and Y-axis Components.

Combination Type	X-Axis Module and Part Numbers		Y-Axis Module and Part Numbers		Combining Bracket Type and Part Number	
P1	H	90400-10**0	M	90400-200*5	GHM	90400-05002
P2	M	90400-200*5	S	90400-300*3	GMS	90400-05001

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Table 5-2. P-Type Configuration Z-axis Components

Combination Type	Z-Axis Module and Part Numbers		Combining Bracket Type and Part Number	
P1	S_z	90400-400*3	DMS	90400-05006
P2	S_z	90400-400*3	DSS	90400-05007

5.3 P-1 Type Installation Procedure

1. Insert the X-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm). Refer to the section "Inserting the Chamfered and Straight Pin Into a Bracket" on page 64.
2. Insert the Y-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm). Refer to the section "Inserting the Chamfered and Straight Pin Into a Bracket" on page 64.
3. Insert the Z-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm). Refer to the section "Inserting the Chamfered and Straight Pin Into a Bracket" on page 64.
4. Mate the L-shaped combining bracket to the X-axis slider. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (refer to Table 3-3 for the mounting bolt specifications).
5. Mate the Y-axis to combining bracket by aligning the motor-side pin holes on the Y-axis module to the pins on the side of the bracket (these holes are on the side opposite the sliders). Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (see Figure 5-3, and refer to Table 3-1 to Table 3-3 for the mounting bolt specifications).
6. Mate the Z-axis combining bracket to the Z-axis. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (refer to Table 3-3 for the mounting bolt specifications).
    a. Mounting the Z-axis for slider stroke: mount the combining bracket to the screw holes on the Z-axis rear surface.
    b. Mounting the Z-axis for unit stroke: mount the combining bracket to the Z-axis slider.
7. Mate the Z-axis with the combining bracket by aligning the pin holes on the Y-axis module slider to the pins on the side of the Z-axis bracket. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (see Figure 5-3, and refer to Table 3-3 for the mounting bolt specifications).

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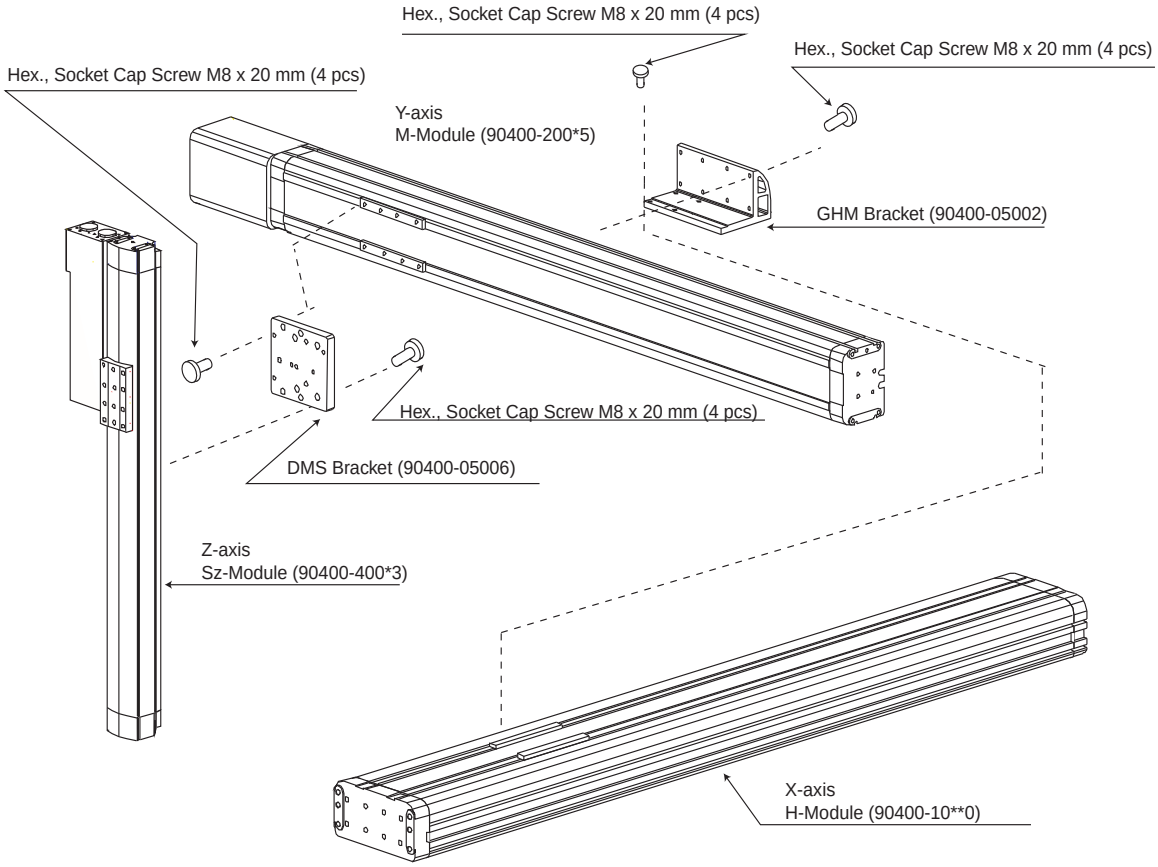


Figure 5-3. P-1 Type Mechanical Assembly

P-1 Type Electrical Connections

The applicable ranges of robot and controller cables are shown in Table 5-3. Verify that you have compatible cables before beginning assembly.

Table 5-3. P-1 Type Cable Options

Cable Type	EXC, EXA Controller Cable	Adept MV Interface Cable
Y-Axis Robot Cable	90400-07**5	90400-07**5
Z-Axis Robot Cable	90400-071*5	90400-071*5
Controller Cable (1 per axis)	90400-03003	
Interface Cable (1 per axis)		10400-070**

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Table 5-3. P-1 Type Cable Options (Continued)

Cable Type	EXC, EXA Controller Cable	Adept MV Interface Cable
Cable track assemblies for Extended stroke models	90400-08012 90400-08007	

NOTE: Adept recommends using cable tracks for extended stroke configurations. See Section 4.3 for cable track installation.

EXA and EXC Electrical Connections

1. Connect the X-axis controller cable:
   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 5-4. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “1-CN6 MOTOR 1” and “1-CN5 SENSOR 1”.
2. Connect the Y-axis cables:
   a. Connect the C holder end of the robot cable to the motor end of the Y-axis (see Section 4.3 for holder mounting).
   b. Attach the A holder end of the robot cable to the side of the X-axis as shown in Figure 5-4 (refer to Section 4.3 for holder mounting).
   c. Connect the two barrel ends of the controller cable to the Y-axis cable (holder A) as shown in Figure 5-4. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.
3. Connect the Z-axis cables:
   a. Connect the C holder end of the robot cable to the motor end of the Z-axis (see Section 4.3 for holder mounting).
   b. Attach the A holder end of the robot cable to the side of the X-axis as shown in Figure 5-4 (refer to Section 4.3 for holder mounting).
   c. Connect the two barrel ends of the controller cable to the Z-axis cable (holder A) as shown in Figure 5-4. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 3” and “2-CN5 SENSOR 3”.
4. Position the X and Y axes to the center of their stroke. Rotate the cable holders on the Y- and Z-axis so that the cables stand upright (refer to section Section 4.3 for cable holder rotation).

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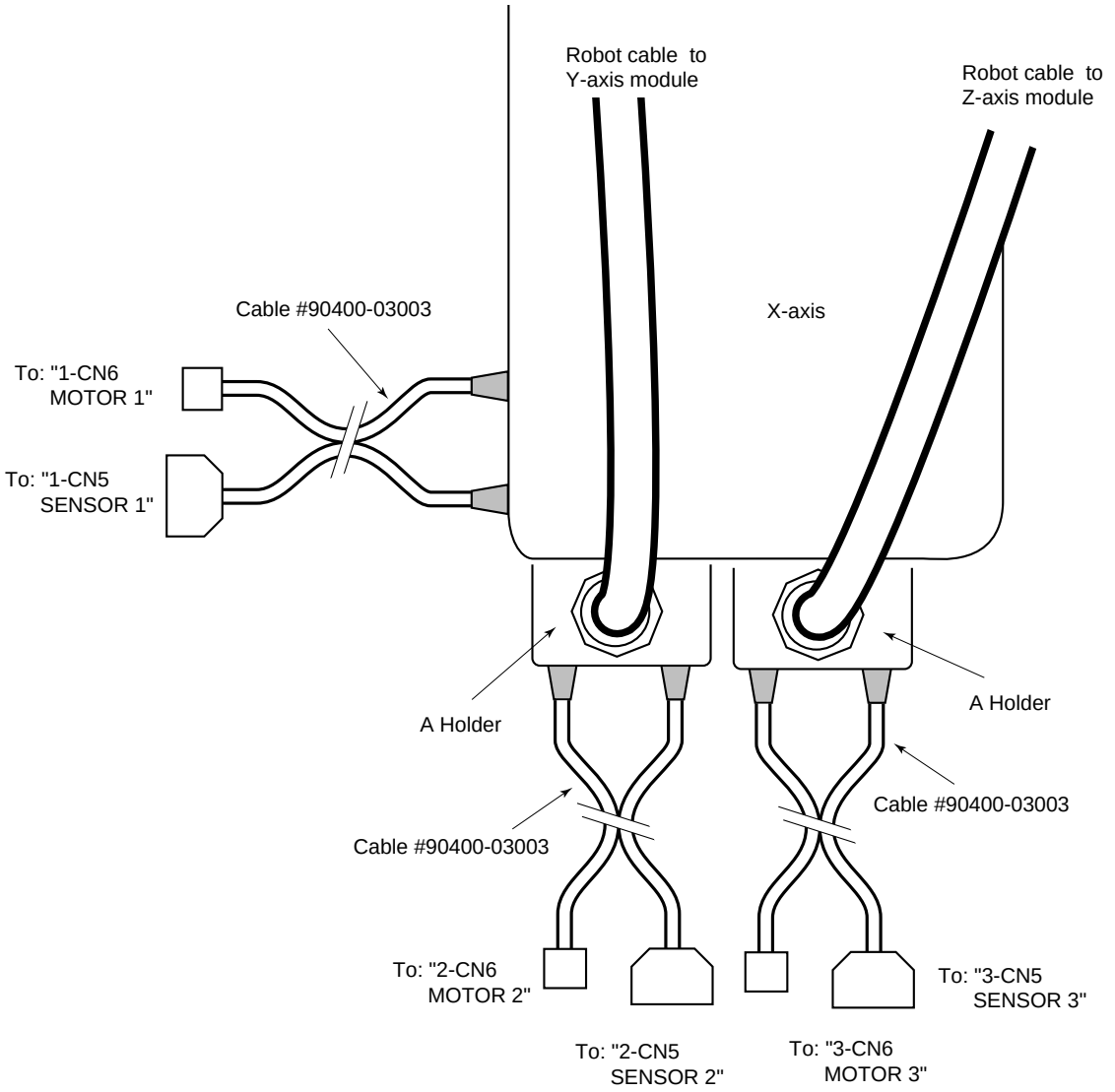


Figure 5-4. Connecting to an EXA or EXC Controller

Adept MV Controller Connections

1. Connect the X-axis controller cable:
   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 5-5. These connectors have different pin sizes and cannot be installed incorrectly.
   b. The D-sub connector connects to the Signal Interface Box connector marked "Axis 1". The final connector connects to the Axis 1 end of the B^+ Amp break-out cable.
2. Connect the Y-axis cables:
   a. Connect the C holder end of the robot cable to the motor end of the Y-axis (see Section 4.3 for holder mounting).

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b. Attach the A holder end of the robot cable to the side of the X-axis as shown in Figure 5-5 (refer to Section 4.3 for holder mounting).

c. Connect the two barrel ends of the cable to the A holder as shown in Figure 5-5. These connectors have different pin sizes and cannot be installed incorrectly.

d. The D-sub connector connects to the Signal Interface Box connector marked "Axis 2".

e. The final connector connects to the Axis 2 end of the B^+ Amp break-out cable (cable# 10400-00600).

3. Connect the Z-axis cables:

a. Connect the C holder end of the robot cable to the motor end of the Z-axis (see Section 4.3 for holder mounting).

b. Attach the A holder end of the robot cable to the side of the X-axis as shown in Figure 5-5 (refer to Section 4.3 for holder mounting).

c. Connect the two barrel ends of the cable to the A holder as shown in Figure 5-5. These connectors have different pin sizes and cannot be installed incorrectly.

d. The D-sub connector connects to the Signal Interface Box connector marked "Axis 3".

e. The final connector connects to the Axis 1 end of the second B^+ Amp break-out cable (cable# 10400-00600).

4. Position the X- and Y-axes to the center of their stroke. Rotate the cable holders (holder A's) on the Y- and Z-axis so that the cables stand upright (refer to section Section 4.3 for cable holder rotation).

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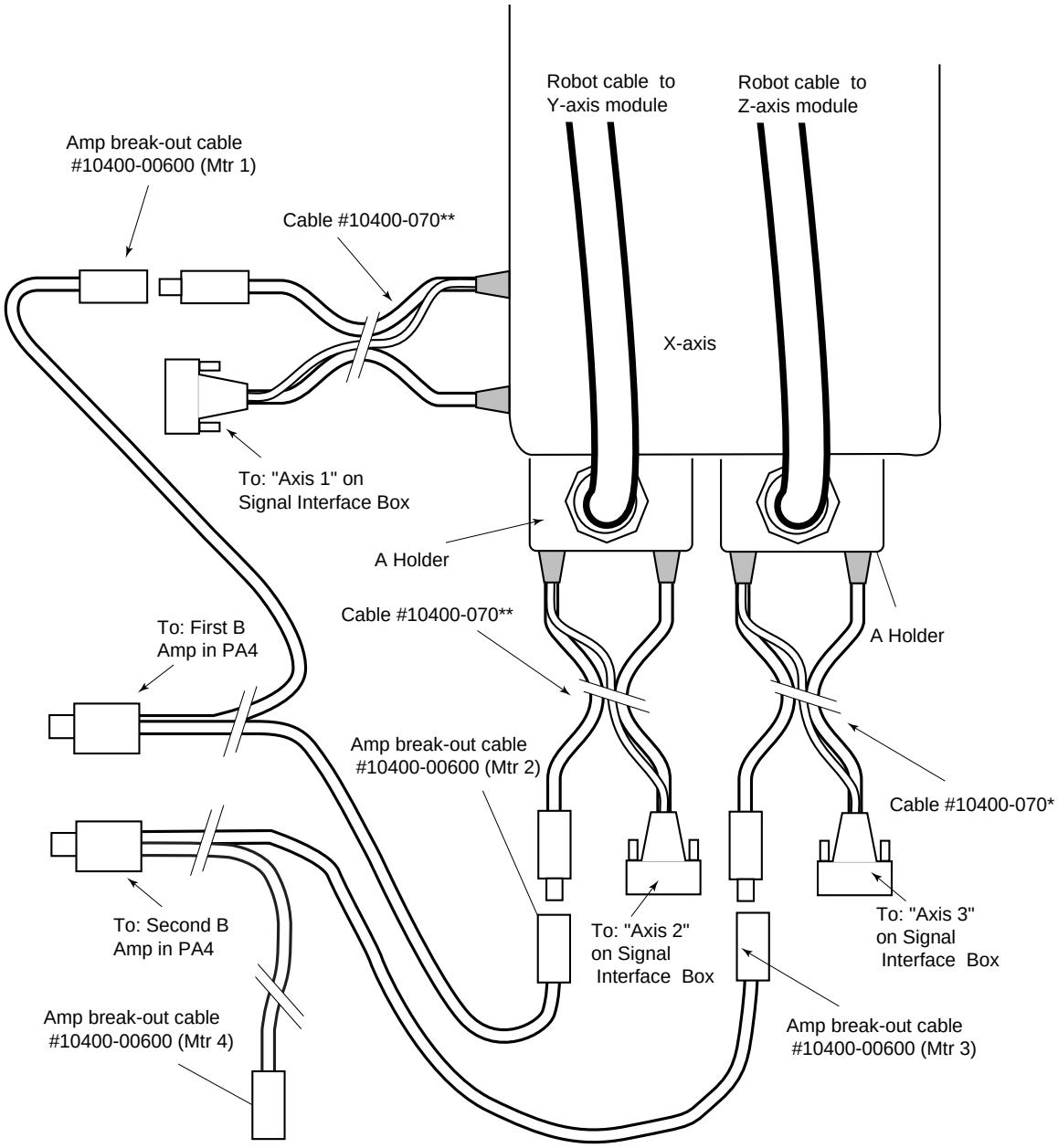


Figure 5-5. Connecting to an Adept MV Controller

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5.4 P1 Extended Stroke Cable Track Installation

When using extended stroke modules and certain other configurations, Adept recommends the use of cable tracks.

Follow these directions to install cable tracks (see Figure 4-18).

1. Slide the module rail keys into the X-axis. The cable rests mount to these keys.
2. Mount the cable rests using M3 x 6 screws. Start with the cable track support away from the motor side of the module and torque to 1.47 N • m (13.0 in • lb).
3. Mount the remaining cable track supports and cable track support bracket (nonmoving side) to the X-axis in the same manner as steps 1 and 2.

   NOTE: In some configurations the cable track supports must be mounted to the systems base vice the X-axis. In this case Drill M6-25.4 mm tapped holes and mount supports to the base with M6 screws, 10mm long, tighten to 1.47 N • m (13.0 lb • in).

4. Mount the cable track support bracket (moving side) with M3-6 screws to the axis combining bracket and tighten to 1.47 N • m (13.0 in • lb).
5. Position the cable track along the X-axis cable track supports with the cable support fixture on the cable track support bracket (nonmoving side).
6. Using 4 nuts, mount the cable support fixture to the cable track support fixture (nonmoving side), tighten to 1.47 N • m (13.0 in • lb).
7. Mount the other support fixture of the cable track to the cable track support bracket (moving side) with 4 screws and tapped securing plate. Place the securing plate under the cable track support bracket and tighten to 1.47 N • m (13.0 in • lb).

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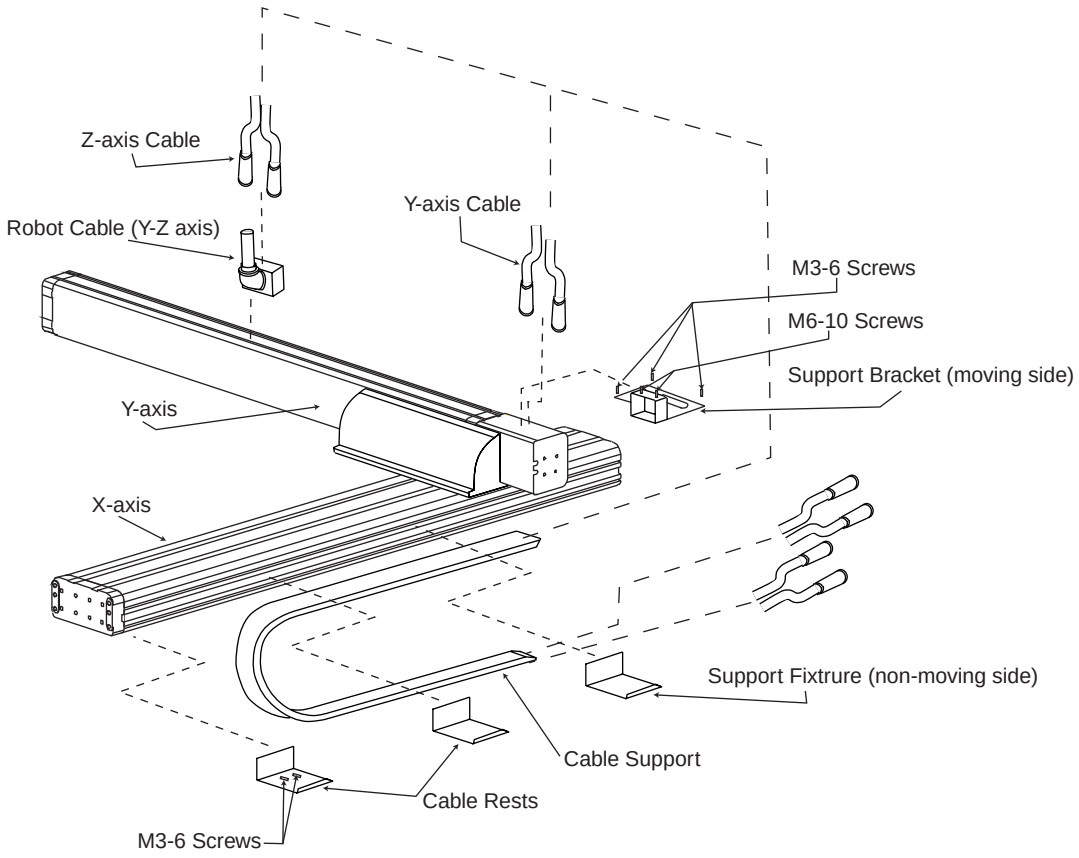


Figure 5-6. Cable Tracks

8. Mount the C-holder of the Z-axis robot cable to the Y-axis and the other holder to the Z-axis connectors with M3-57 screws and torque to 1.47 N • m (13.0 in • lb).

   NOTE: Cable holders will have to be rotated so that the cable stands upright. Refer to page 64 for directions on changing the angle of the cable holders.

9. Connect all cable connectors to the controller and axis as described in the above electrical connection procedures.

   NOTE: Adept recommends labeling the cables, with the enclosed labels, on the connectors to avoid misconnection and damage to the AdeptModules system.

Adding User Cables to the Cable Track

When adding user cables to the cable tracks open the top of the cable track using a standard screw driver (see Figure 5-7). Be aware of the cross-sectional area of the cable track for the amount of space for user cables and air hoses.

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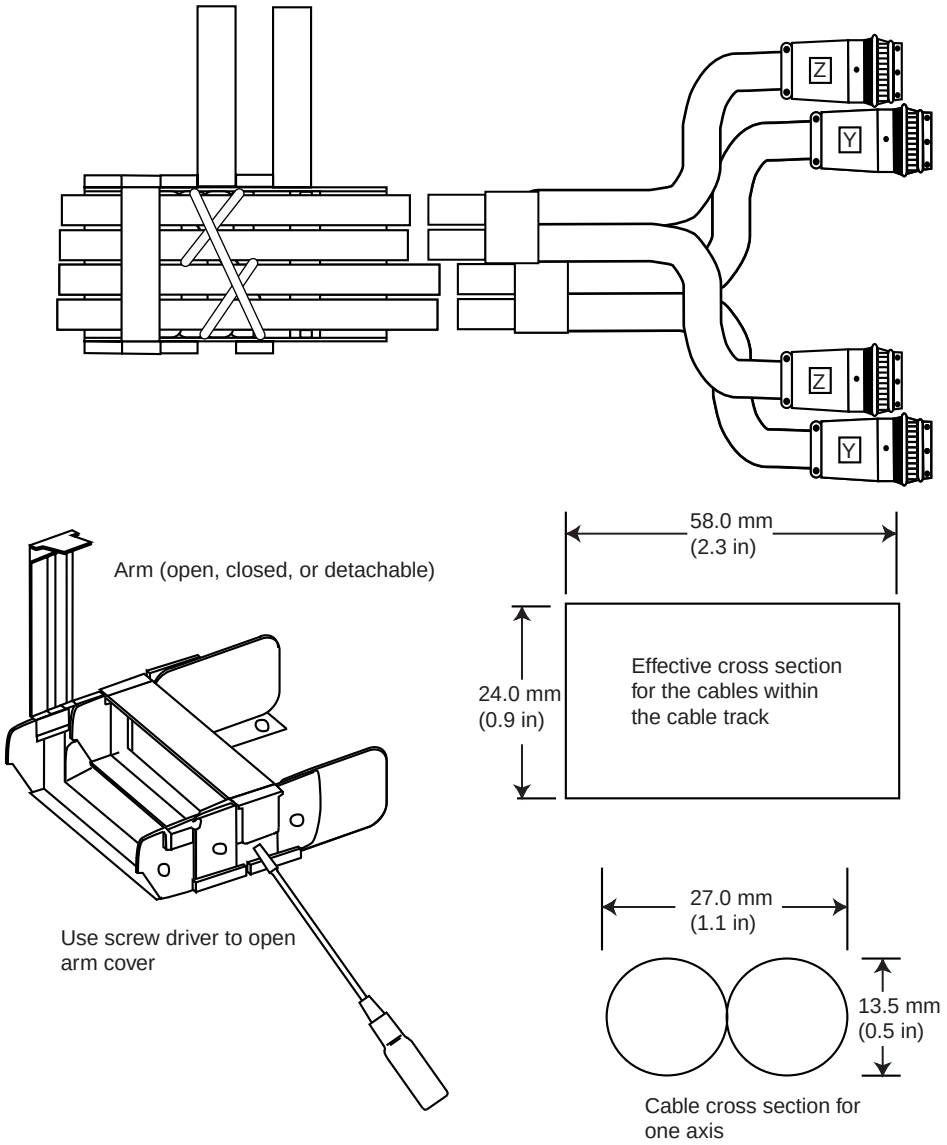


Figure 5-7. Cable Track User Cable Installation

5.5 P-2 Type Installation Procedure

1. Insert the X-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm). Refer to the section “Inserting the Chamfered and Straight Pin Into a Bracket” on page 64.
2. Insert the Y-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm). Refer to the section “Inserting the Chamfered and Straight Pin Into a Bracket” on page 64.
3. Insert the Z-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm).

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4. Mate the L-shaped combining bracket to the X-axis slider. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (refer to Table 3-3 for the mounting bolt specifications).
5. Mate the Y-axis to combining bracket by aligning the motor-side pin holes on the Y-axis module to the pins on the side of the bracket (these holes are on the side opposite the sliders). Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (see Figure 5-8, and refer to Table 3-3 for the mounting bolt specifications).
6. Mate the Z-axis combining bracket to the Z-axis. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (refer to Table 3-3 for the mounting bolt specifications).
    a. To mount Z-axis for slider stroke: Mount the combining bracket to the screw holes on the Z-axis rear surface.
    b. To mount the Z-axis for unit stroke: Mount the combining bracket to the Z-axis slider.
7. Mate the Z-axis and combining bracket by aligning the pin holes on the Y-axis module to the pins on the side of the Z-axis bracket. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (see Figure 5-8, and refer to Table 3-3 for the mounting bolt specifications).

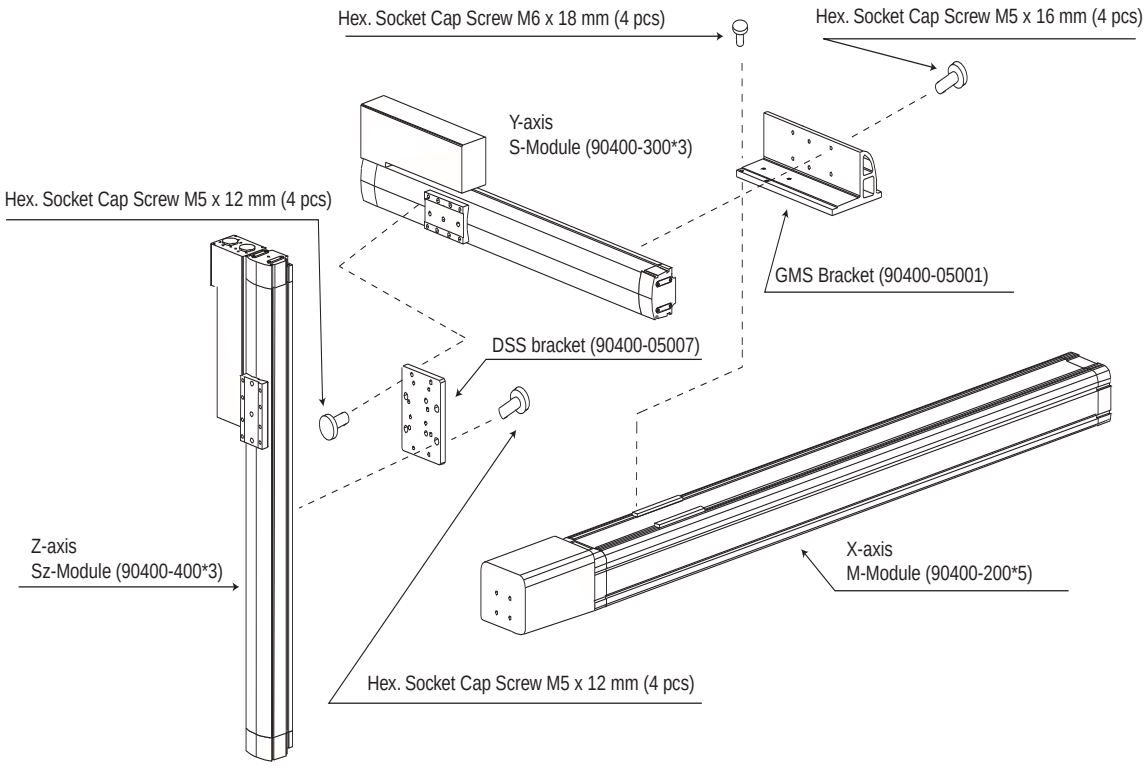


Figure 5-8. P-2 Type Mechanical Assembly

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P-2 Type Electrical Connections

The applicable ranges of robot and controller cables are shown in Table 5-4. Verify that you have compatible cables before beginning assembly.

Table 5-4. P-2 Type Cable Options

Cable Type	EXC, EXA Controller Cable	Adept MV Interface Cable
Y-Axis Robot Cable	90400-07**5	90400-07**5
Z-Axis Robot Cable	90400-071*5	90400-071*5
Controller Cable (1 per axis)	90400-03003	
Interface Cable (1 per axis)		10400-070**
Cable track assemblies for Extended stroke models	90400-08012 90400-08007	

NOTE: Adept recommends using cable tracks for extended stroke configurations. See Section 4.3 for cable track installation.

EXA and EXC Electrical Connections

1. Connect the X-axis cables:
   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 5-9. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “1-CN6 MOTOR 1” and “1-CN5 SENSOR 1”.
2. Connect the Y-axis cables:
   a. Connect the C holder end of the robot cable to the motor end of the Y-axis (see Section 4.3 for holder mounting).
   b. Attach the A holder end of the robot cable to the side of the X-axis as shown in Figure 5-9 (refer to Section 4.3 for holder mounting).
   c. Connect the two barrel ends of the controller cable to the Y-axis cable (holder A) as shown in Figure 5-9. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.
3. Connect the Z-axis cables:
   a. Connect the C holder end of the robot cable to the motor end of the Z-axis (see Section 4.3 for holder mounting).
   b. Attach the A holder end of the robot cable to the side of the X-axis as shown in Figure 5-9 (refer to Section 4.3 for holder mounting).

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c. Connect the two barrel ends of the controller cable to the Z-axis cable (holder A) as shown in Figure 5-9. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 3” and “2-CN5 SENSOR 3”.

4. Position the X- and Y-axis to the center of their stroke. Rotate the cable holders (holder As) on the Y- and Z-axes so that the cables stand upright (refer to section Section 4.3 for cable holder rotation).

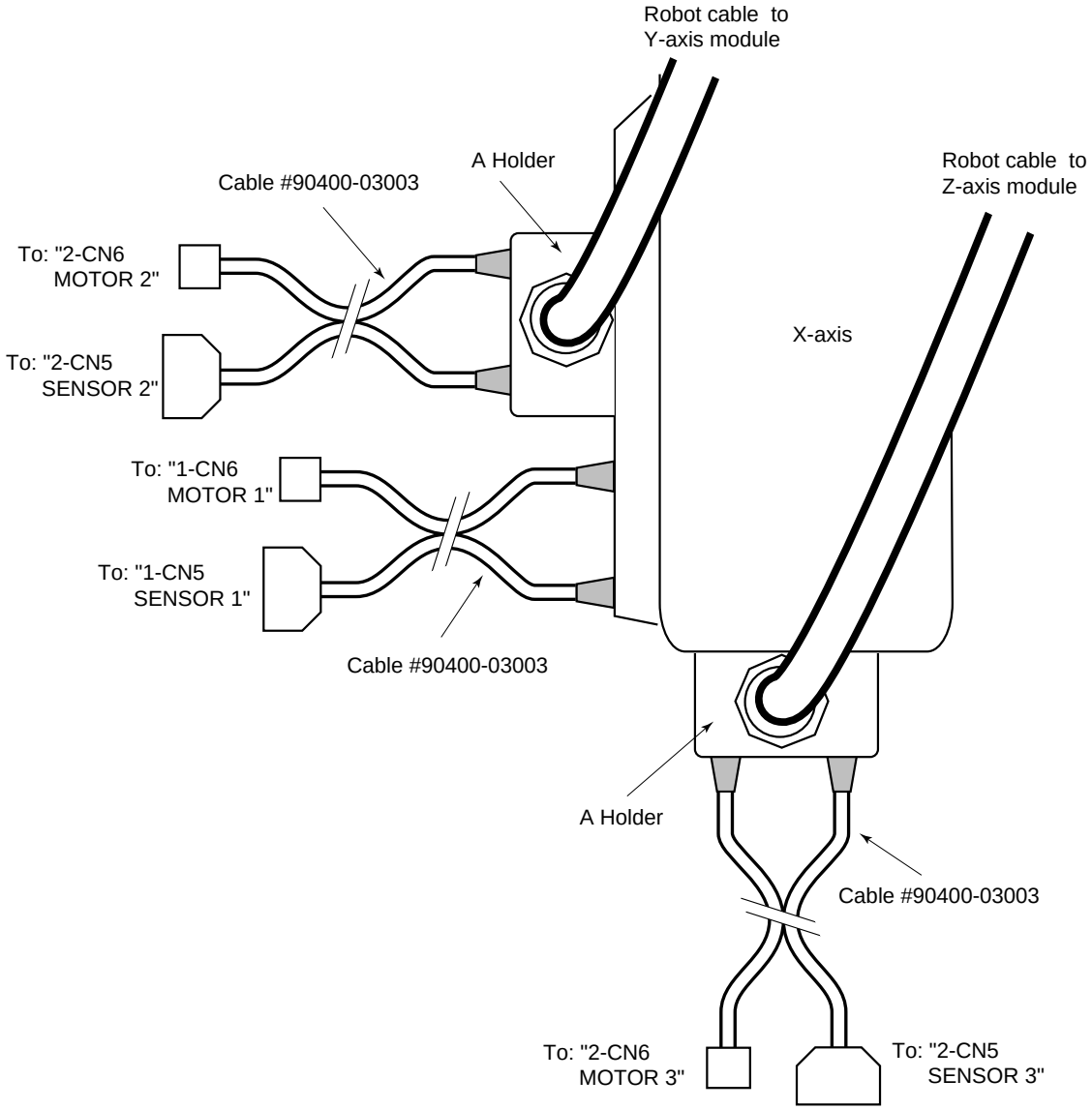


Figure 5-9. Connecting to an EXA or EXC Controller

Adept MV Controller Connections

1. Connect the X-axis cables:

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a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 5-10. These connectors have different pins sizes and cannot be installed incorrectly.

b. The D-sub connector connects to the Signal Interface Box connector marked “Axis 1”. The final connector connects to the Axis 1 end of the B^+ Amp break-out cable.

2. Connect the Y-axis cables:

a. Connect the C holder end of the robot cable to the motor end of the Y-axis (see Section 4.3 for holder mounting).

b. Attach the A holder end of the robot cable to the side of the X-axis as shown in Figure 5-10 (refer to Section 4.3 for holder mounting).

c. Connect the two barrel ends of the cable to the A holder as shown in Figure 5-10. These connectors have different pin sizes and cannot be installed incorrectly.

d. The D-sub connector connects to the Signal Interface Box connector marked “Axis 2”.

e. The final connector connects to the Axis 2 end of the B^+ Amp break-out cable (cable# 10400-00600).

3. Connect the Z-axis cables:

a. Connect the C holder end of the robot cable to the motor end of the Z-axis (see Section 4.3 for holder mounting).

b. Attach the A holder end of the robot cable to the side of the X-axis as shown in Figure 5-10 (refer to Section 4.3 for holder mounting).

c. Connect the two barrel ends of the cable to the A holder as shown in Figure 5-10. These connectors have different pin sizes and cannot be installed incorrectly.

d. The D-sub connector connects to the Signal Interface Box connector marked “Axis 3”.

e. The final connector connects to the Axis 1 end of the second B^+ Amp break-out cable (cable# 10400-00600).

4. Position the X- and Y-axes to the center of their stroke. Rotate the cable holders on the Y- and Z-axis so that the cables stand upright (refer to section Section 4.3 for cable holder rotation).

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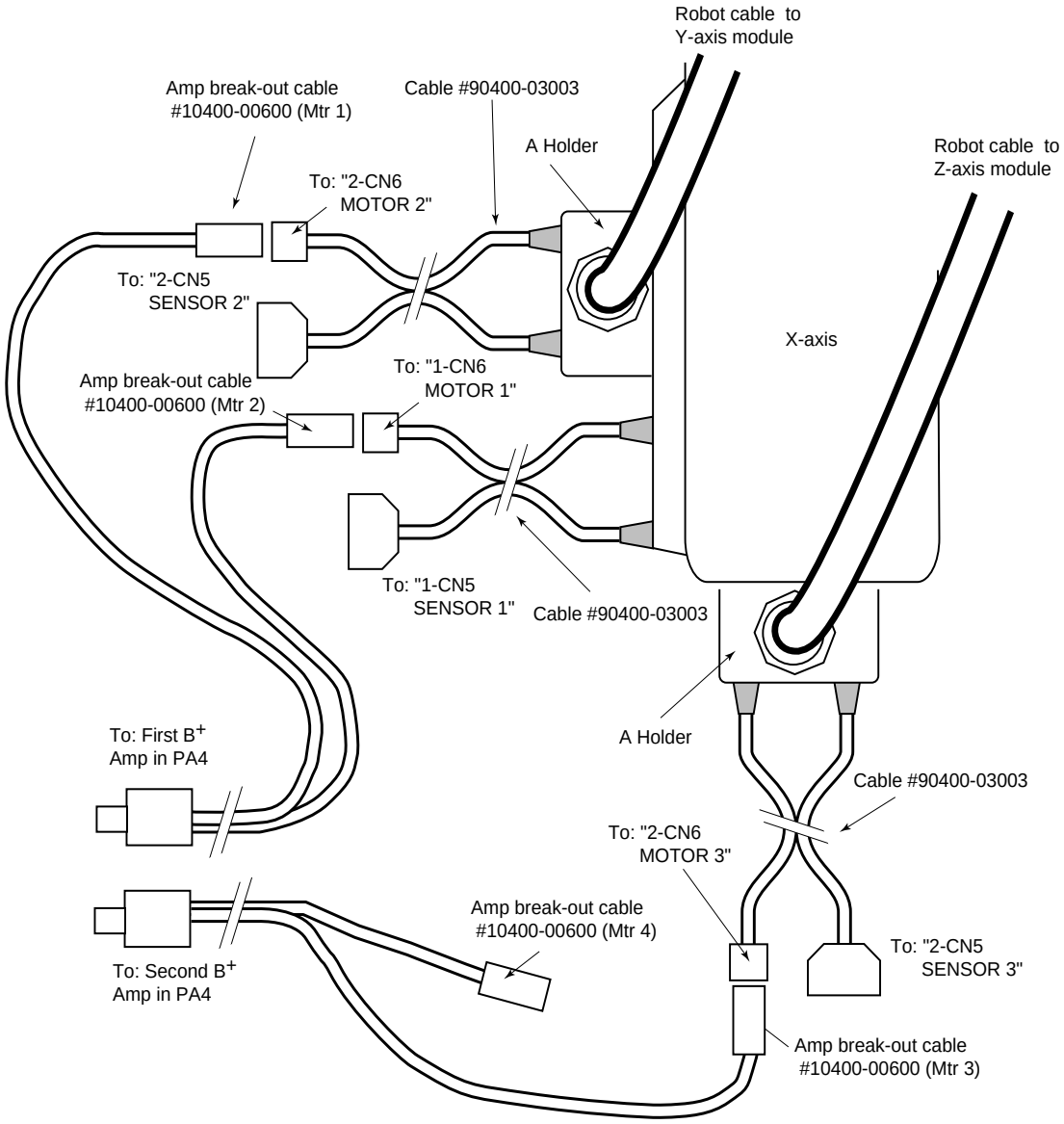


Figure 5-10. Connecting to an Adept MV Controller

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5.6 Assembling J-Type Combinations

In a J-type configuration the combining bracket mounts to the slider of the X and Y-axis unit, and to the body or slider of the Z-axis unit. A Z-axis slider stroke is shown in Figure 5-11.

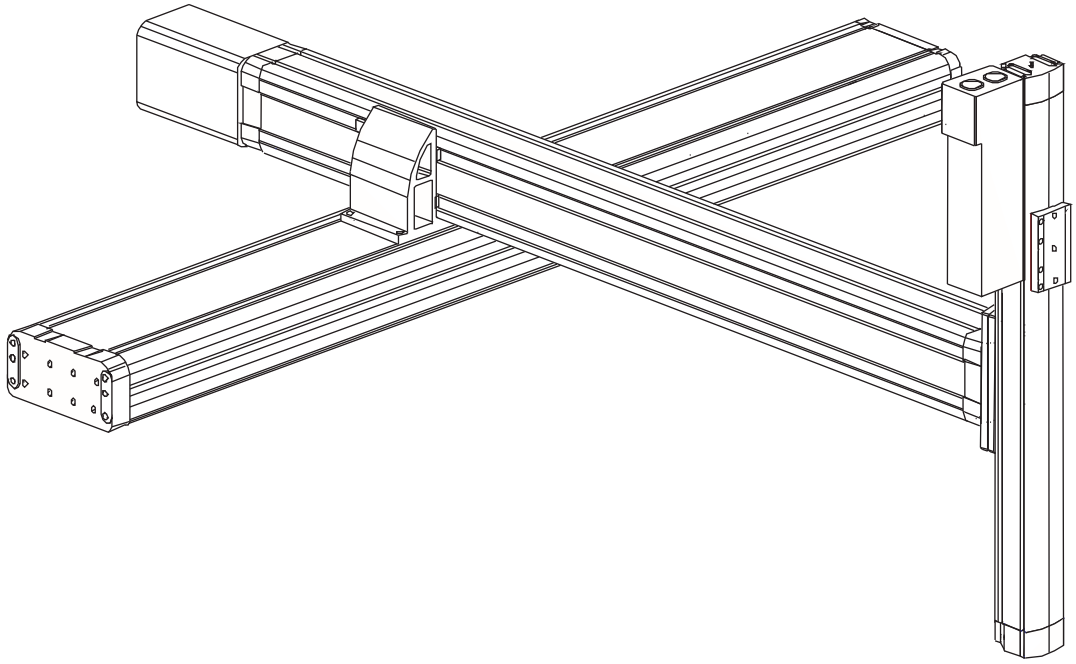


Figure 5-11. J-Type Combination with Z-axis Slider Stroke

The applicable ranges of modules and their combining brackets are shown in Table 5-5 and Table 5-6. Verify that you have compatible X-axis, Y-axis, Z-axis, and combining bracket components before beginning assembly.

Table 5-5. J-Type Configuration X- and Y-Axis Components

Combination Type	X-Axis Module and Part Numbers		Y-Axis Module and Part Numbers		Combining Bracket Type and Part Number	
J	H	90400-10**0	M	90400-200*5	XHM	90400-05009

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Table 5-6. J-Type Configuration Z-Axis Components

Combination Type	Z-Axis Module and Part Numbers		Combining Bracket Type and Part Number	
J	S_z	90400-400*3	CMS	90400-05012

5.7 J Type Installation Procedure

1. Insert the X-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm). Refer to the section "Inserting the Chamfered and Straight Pin Into a Bracket" on page 64.
2. Insert the Y-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm). Refer to the section "Inserting the Chamfered and Straight Pin Into a Bracket" on page 64.
3. Insert the Z-axis chamfered and straight pins into the bracket and seat with a rubber mallet (the pins must not project more than 8 mm). Refer to the section "Inserting the Chamfered and Straight Pin Into a Bracket" on page 64.
4. Mate the L-shaped combining bracket to the X-axis slider. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (refer to Table 3-3 for the mounting bolt specifications).
5. Mate the Y-axis to combining bracket by aligning the slider pin holes on the Y-axis module to the pins on the side of the bracket. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (see Figure 5-12, and refer to Table 3-3 for the mounting bolt specifications).
6. Mate the Z-axis combining bracket to the Z-axis. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (refer to Table 3-3 for the mounting bolt specifications).
   a. To mount Z-axis for slider stroke: Mount the combining bracket to the screw holes on the Z-axis rear surface.
   b. To mount the Z-axis for unit stroke: Mount the combining bracket to the Z-axis slider.
7. Mate the Z-axis and combining bracket by aligning the pin holes on the Y-axis module end plate to the pins on the side of the Z-axis bracket. Carefully mate the pins and pin holes to avoid damaging the pins. Install the mounting bolts (see Figure 5-12, and refer to Table 3-3 for the mounting bolt specifications).

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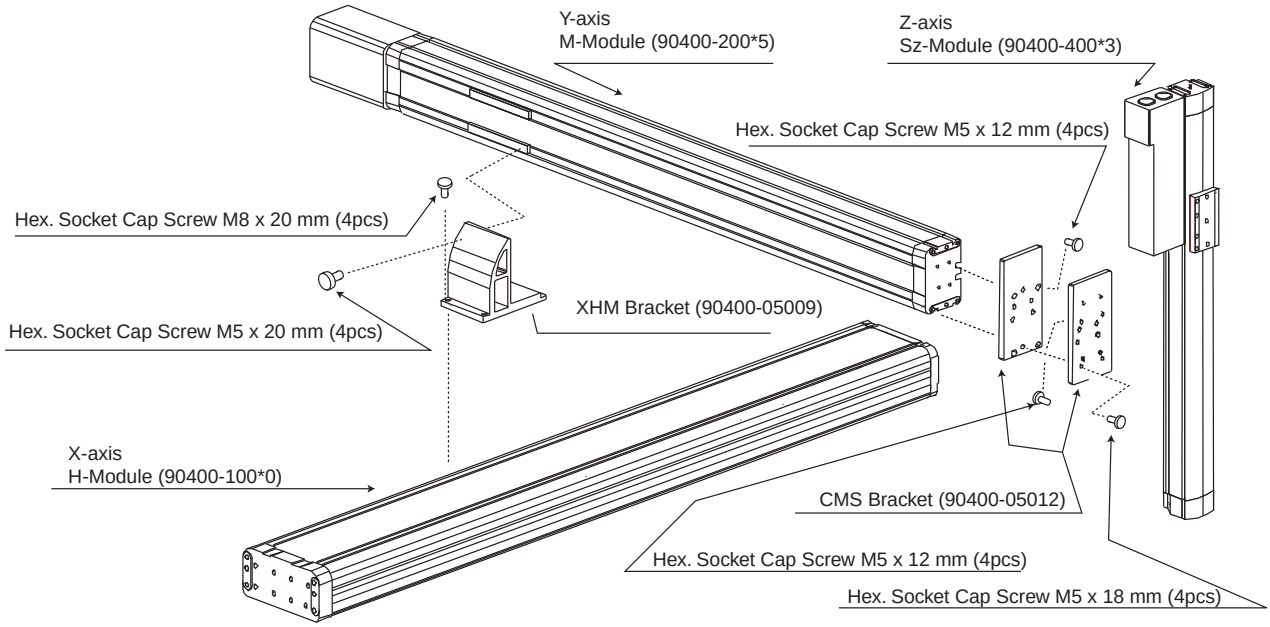


Figure 5-12. J-Type Mechanical Assembly with Z-axis Slider Stroke

J Type Electrical Connections

The applicable ranges of robot and controller cables areshown in Table 5-7. Verify that you have compatible cables before beginning assembly.

Table 5-7. J-Type Cable Options

Cable Type	EXC, EXA Controller Cable	Adept MV Interface Cable
Y-Axis Robot Cable	90400-07**5	90400-07**5
Z-Axis Robot Cable	90400-071*5	90400-071*5
Controller Cable (1 per axis)	90400-03003	
Interface Cable (1 per axis)		10400-070**
Cable track assemblies for Extended stroke models	90400-08012 90400-08007	

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NOTE: Adept recommends using cable tracks for extended stroke configurations. See Section 4.3 for cable track installation.

EXA and EXC Electrical Connections

1. Connect the X-axis controller cable:
   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 5-13. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “1-CN6 MOTOR 1” and “1-CN5 SENSOR 1”.
2. Connect the Y-axis cables:
   a. Connect the C holder end of the robot cable to the motor end of the Y-axis (see Section 4.3 for holder mounting).
   b. Attach the A holder end of the robot cable to the side of the X-axis as shown in Figure 5-13 (refer to Section 4.3 for holder mounting).
   c. Connect the two barrel ends of the controller cable to the Y-axis cable (holder A) as shown in Figure 5-13. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 2” and “2-CN5 SENSOR 2”.
3. Connect the Z-axis cables:
   a. Connect the C holder end of the robot cable to the motor end of the Z-axis (see Section 4.3 for holder mounting).
   b. Attach the A holder end of the robot cable to the end of the X-axis as shown in Figure 5-13 (refer to Section 4.3 for holder mounting).
   c. Connect the two barrel ends of the controller cable to the Z-axis cable (holder A) as shown in Figure 5-13. These connectors have different pin sizes and cannot be installed incorrectly. The other ends connect to the controller connections marked “2-CN6 MOTOR 3” and “2-CN5 SENSOR 3”.
4. Position the X- and Y-axes to the center of their stroke. Rotate the cable holders (holder As) on the Y- and Z-axis so that the cables stand upright (refer to section Section 4.3 for cable holder rotation).

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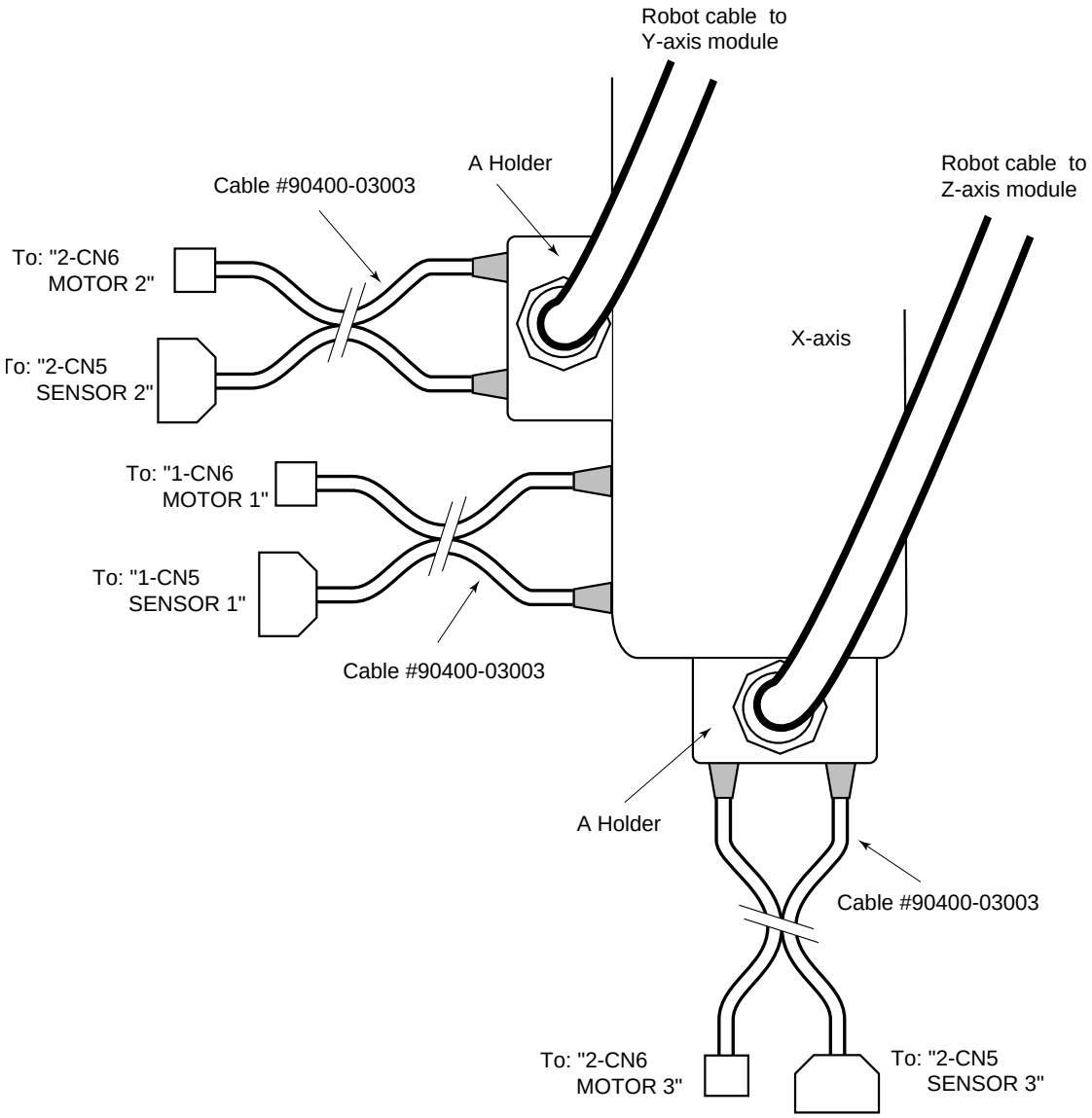


Figure 5-13. Connecting to an EXA or EXC Controller

Adept MV Controller Connections

1. Connect the X-axis controller cable:

   a. Connect the two barrel ends of the cable to the X-axis module as shown in Figure 5-14. These connectors have different pin sizes and cannot be installed incorrectly.

   b. The D-sub connector connects to the Signal Interface Box connector marked "Axis 1". The final connector connects to the Axis 1 end of the B^+ Amp break-out cable.

2. Connect the Y-axis cables:

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a. Connect the C holder end of the robot cable to the motor end of the Y-axis (see Section 4.3 for holder mounting).

b. Attach the A holder end of the robot cable to the side of the X-axis as shown in Figure 5-14 (refer to Section 4.3 for holder mounting).

c. Connect the two barrel ends of the cable to the A holder as shown in Figure 5-14. These connectors have different pin sizes and cannot be installed incorrectly.

d. The D-sub connector connects to the Signal Interface Box connector marked "Axis 2".

e. The final connector connects to the Axis 2 end of the B^+ Amp break-out cable (cable# 10400-00600).

3. Connect the Z-axis cables:

a. Connect the C holder end of the robot cable to the motor end of the Z-axis (see Section 4.3 for holder mounting).

b. Attach the A holder end of the robot cable to the end of the X-axis as shown in Figure 5-14 (refer to Section 4.3 for holder mounting).

c. Connect the two barrel ends of the cable to the A holder as shown in Figure 5-14. These connectors have different pins sizes and cannot be installed incorrectly.

d. The D-sub connector connects to the Signal Interface Box connector marked "Axis 3".

e. The final connector connects to the Axis 1 end of the second B^+ Amp break-out cable (cable# 10400-00600).

4. Position the X- and Y-axes to the center of their stroke. Rotate the cable holders on the Y- and Z-axis so that the cables stand upright (refer to section Section 4.3 for cable holder rotation).

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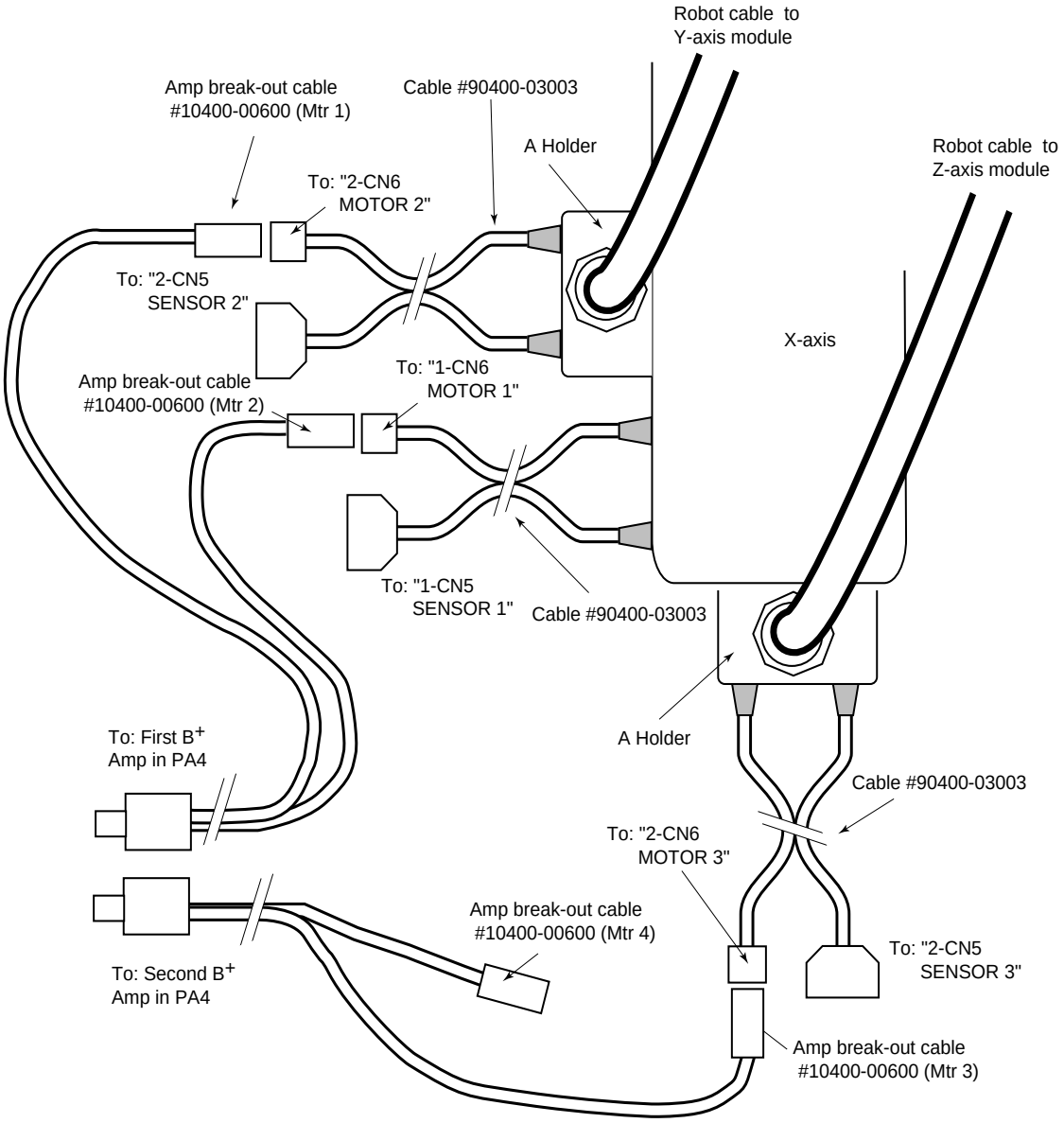


Figure 5-14. Connecting to an Adept MV Controller

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5.8 J Type Extended Stroke Cable Track Installation

When using extended stroke modules and certain other configurations, Adept recommends the use of cable tracks.

Follow these directions to install cable tracks (see Figure 4-18).

1. Slide the module rail keys into the X-axis. The cable track supports mount to these keys.
2. Mount the cable track supports using M3 x 6 screws. Start with the cable track support away from the motor side of the module and torque to 1.47 N • m (13.0 in • lb).
3. Mount the remaining cable track supports and cable track support bracket (nonmoving side) to the X-axis in the same manner as steps 1 and 2.

   NOTE: In some configurations the cable track supports must be mounted to the systems base vice the X-axis. In this case Drill M6-25.4 mm tapped holes and mount supports to the base with M6 screws, 10mm long, and tighten to 1.47 N • m (13.0 lb • in).

4. Mount the cable track support bracket (moving side) with M4-6 screws to the axis combining bracket and tighten to 2.9 N • m (25.6 in • lb).
5. Mount the holder mounting plate to the X-axis cover plate with M5-6 screws and torque to 5.9 N • m (52.2 in • lb).
6. Position the cable track along the X-axis cable track supports with the cable support fixture on the cable track support bracket (non-moving side).
7. Using 4 nuts, mount the cable support fixture to the cable track support bracket (nonmoving side) and tighten to 1.47 N • m (13.0 in • lb).
8. Mount the other support fixture of the cable track to the cable track support bracket (moving side) with 4 screws and tapped securing plate. Place the securing plate under the cable track support bracket and tighten to 1.47 N • m (13.0 in • lb).

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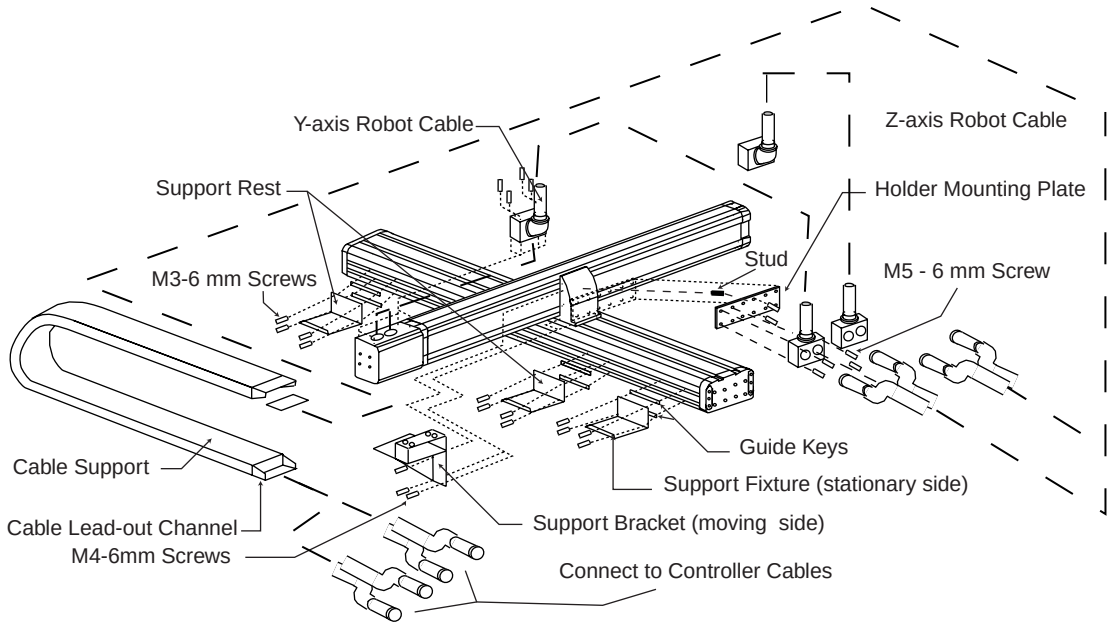


Figure 5-15. Cable Tracks

9. Mount the C-holders (elbow side) of the robot cable to the Y-axis and Z-axis connectors, and the A-holders (straight side) to the holder mounting plate (step 5) with M3-57 screws and torque to 1.47 N • m (13.0 in • lb).

   NOTE: Cable holders will have to be rotated so that the cable stands upright. Refer to page 64 for directions on changing the angle of the cable holders.

10. Connect all cable connectors to the controller and axis as described in the above electrical connection procedures.

    NOTE: Adept recommends labeling the cables, with the enclosed labels, on the connectors to avoid misconnection and damage to the AdeptModules system.

Adding User Cables to the Cable Track

When adding user cables to the cable track, open the top of the cable track using a standard screw driver (see Figure 5-16). Be aware of the cross-sectional area of the cable track for the amount of space for user cables and air hoses.

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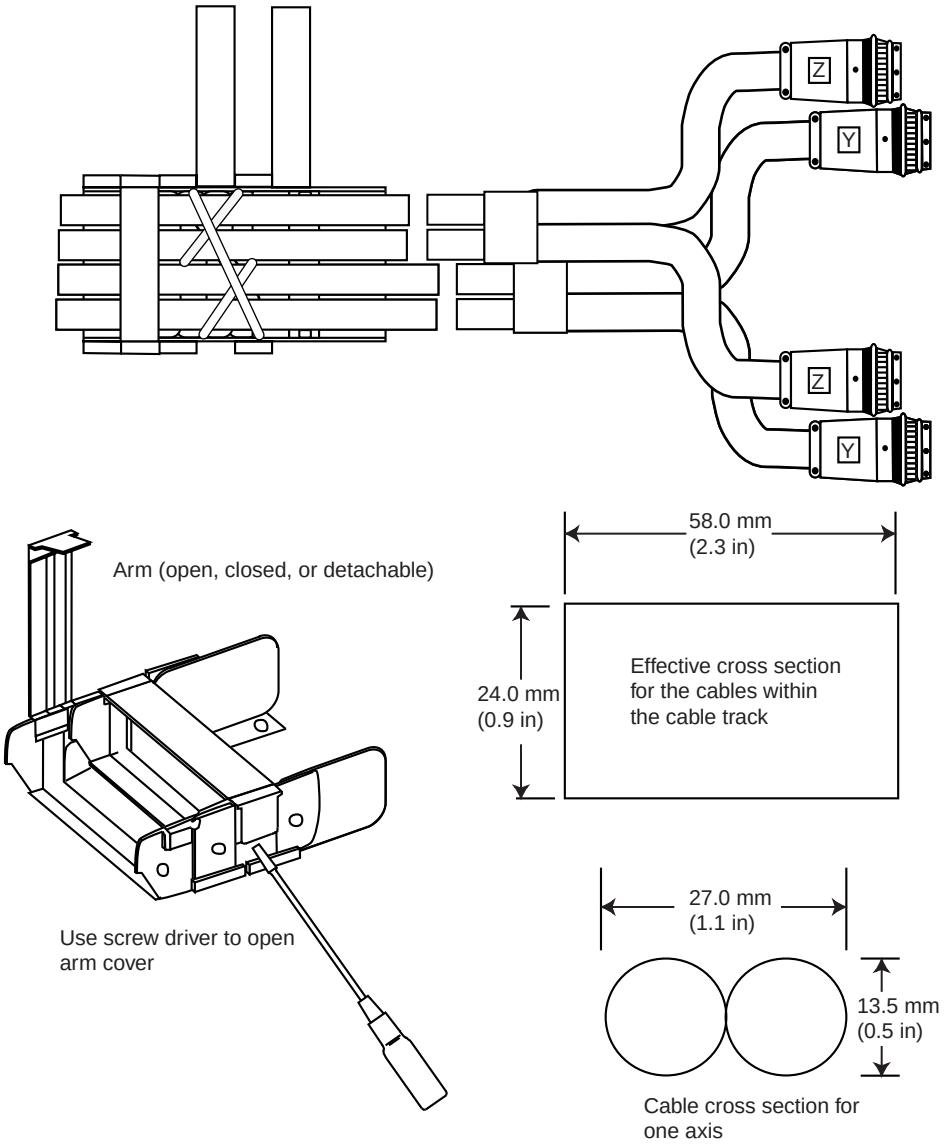


Figure 5-16. Cable Track User Cable Installation

5.9 Mounting Tooling to an AdeptModule

Mounting Attachments on Slider

See the “Technical Specifications” section for specific dimensions of the slider for the individual AdeptModule types.

1. Use fixing bolts specified in Table 5-8 to mount any end-effector to the slider.

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Table 5-8. End-Effector Bolt Specifications

	H-Module	M-Module	S-Module
Bolt Diameter	M8	M6	M5
Screw-In Depth	12-16 mm	9-12 mm	6-8 mm
Tightening Torque	33.3 N • m (340 kgf • cm)	14.7 N • m (150 kgf • cm)	11.7 N • m (120 kgf • cm)

Mounting Attachments on Main Unit End Face

NOTE: Attachment mounting tap holes are also provided on the counter-motor end face of the main unit (on both end faces of the S module).

1. Use fixing bolts specified in Table 5-9 to mount the end-effector or bracket to the slider.

Table 5-9. Fixing Bolt Specification

	H-Module	M-Module	S-Module
Bolt Diameter	M8	M6	M5
Screw-In Depth	12-16 mm	9-12 mm	8-10 mm
Tightening Torque	33.3 N•m (340 kgf•cm)	14.7 N•m (150 kgf•cm)	5.9 N•m (60 kgf•cm)

NOTE: Do not fix the main unit to a base with these fixing bolts. Follow the description in the Fixing Main Unit section to fix the main unit to a base.

NOTE: To determine the maximum transportable work load, see the "Technical Specifications" section, "Transportable Load of Moving Axes" starting on page 198 for single-axis and multi-axis configurations.

5.10 Assembling a Gantry Support Module

Adept recommends the use of the support module (gantry) when system stroke lengths exceed 950 mm in the Y-axis. These configurations include G, D, and P type configurations with the H-Module as the X-axis. Gantry modules come in lengths that match the lengths of the H-Module.

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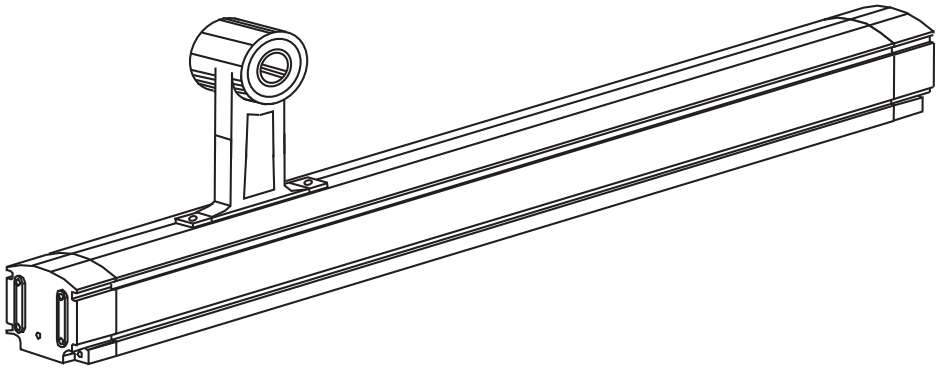


Figure 5-17. Gantry Module

1. Mount the gantry module support bracket to the face plate of the Y-axis of the system. Use M3 x 6 screws and torque to 1.9 N.m (16.8 lb·in)
2. Position the gantry slider to the bracket and slide the bracket stud into the gantry slider.
3. Mount the gantry support module to the mounting base or work station. Refer to Chapter 3 for mounting bolt specifications

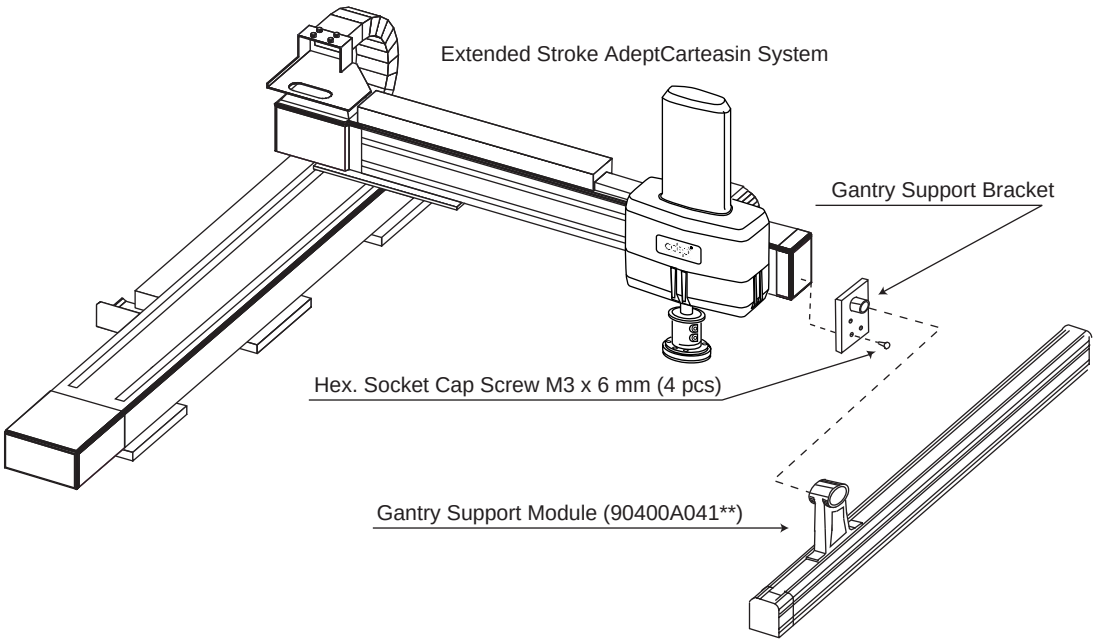


Figure 5-18. Exploded View of the Gantry Module Assembly

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6.1 Assembling an AdeptCartesian Robot

An AdeptCartesian robot is a 4-axis system comprised of two AdeptModules and a 2-axis Z-Theta unit, which provides both vertical and rotational motion. The following illustrates a typical AdeptCartesian robot configuration.

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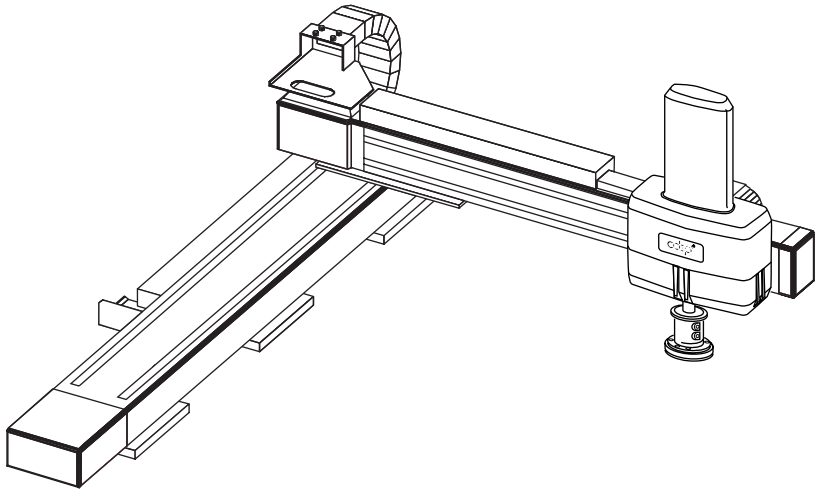


Figure 6-1. AdeptCartesian Robot System

Required Components

Verify that all required components are available before beginning assembly (refer toTable 6-1).

Table 6-1. AdeptCartesian Robot Required Components

Z-Theta Unit	30451-51000
Cable track	10450-63000 Standard or 10451-65000 Extended
H-Module	90400-1****
M-Module	90400-2****
GHM Combining Bracket	90400-05002
H-Module Mounting Brackets	90400-01100
LMMV Interface Cable Set	10451-641**
Module to RSC Box Cable	10400-070**
Signal Interface Box	30400-00200

NOTE: The "*" represents changes in the part number, which varies according to the length of the individual components.

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NOTE: Gantry modules (pt# 90400-041**) are recommended by Adept when stroke lengths exceed 950 mm in the Y-axis.

Assembling the X- and Y-axis should be performed as described in Chapter 4 for the G style configuration. This section gives the assembly instructions for the Z-Theta (third and fourth axis) module.

Procedures

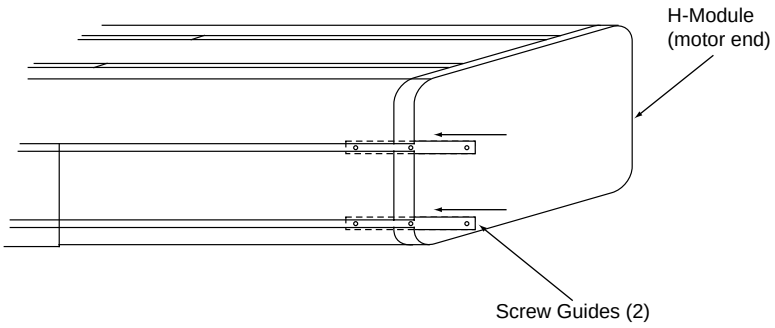


Figure 6-2. Screw Guides

1. Slide the screw guides into the two grooves on the back of the H-Modules as shown in Figure 6-2 (motor end).

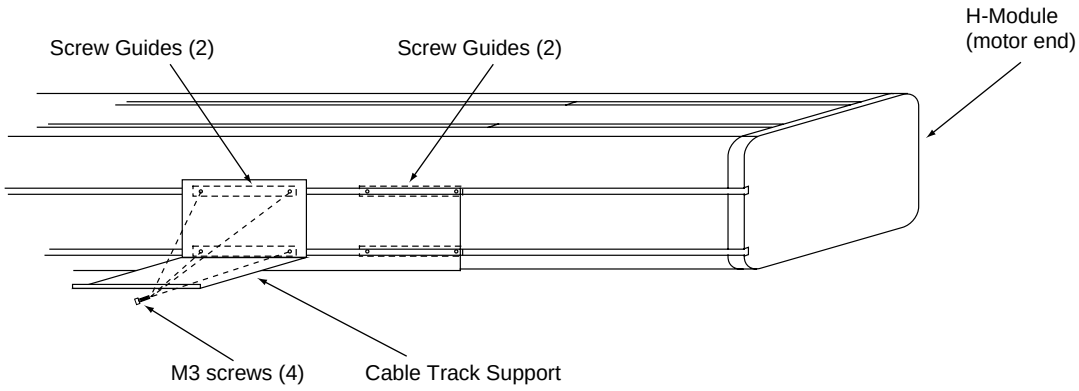


Figure 6-3. Cable Track Supports

2. Align the cable Track Supports for the cable track with the screw guides and attach using four M3 screws. Leave the screws loose for later adjustment (see Figure 6-3).

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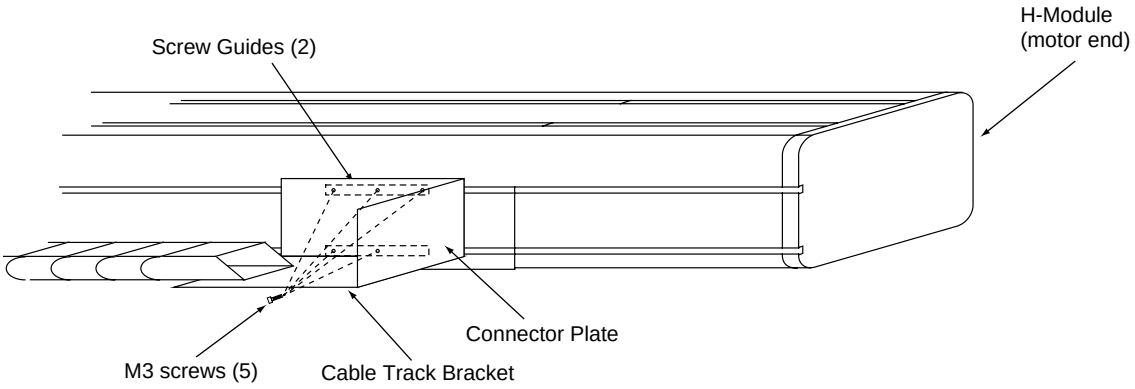


Figure 6-4. Cable Track Bracket Mounting

3. Align the Cable Track bracket with screw guides. Align the cable track supports and the Cable Track Bracket and secure with four M3 screws (see Figure 6-4).

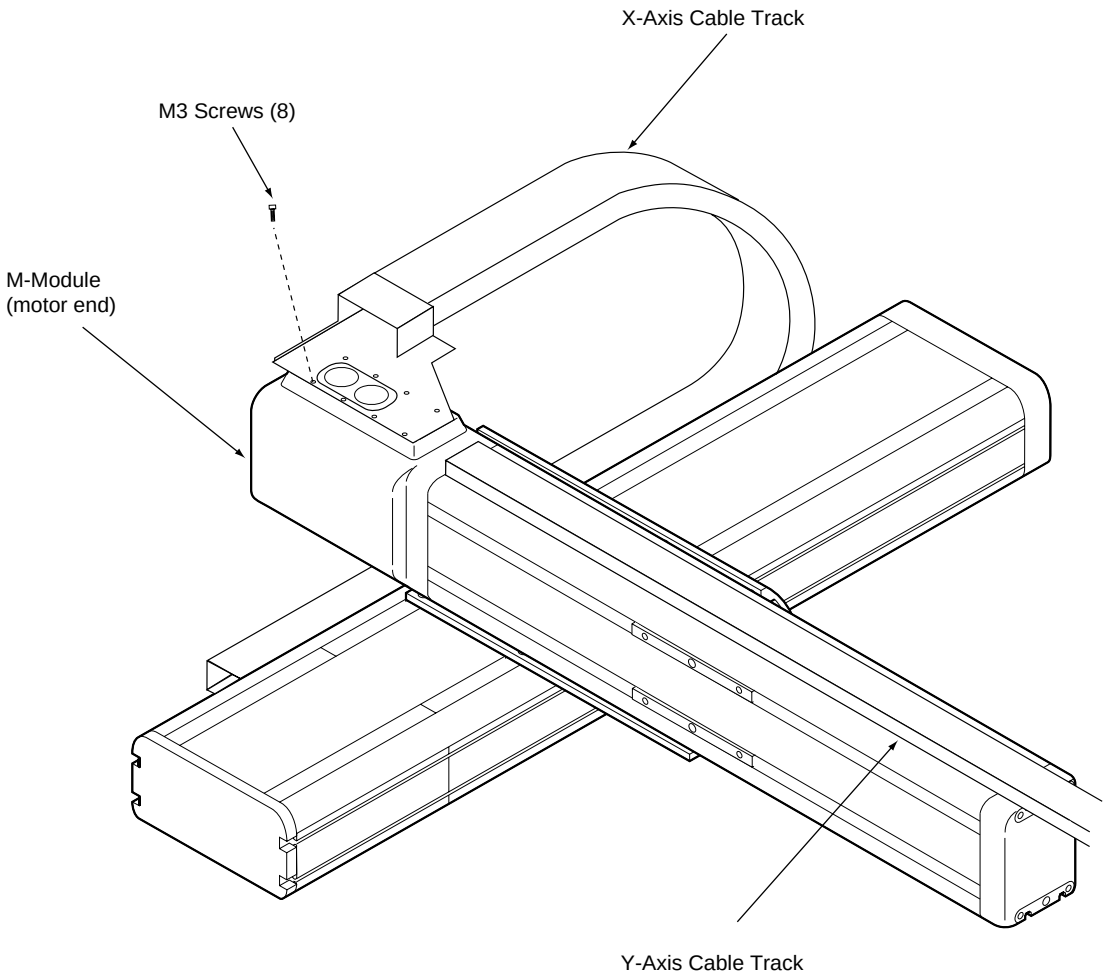


Figure 6-5. Mounting Cable Track to the Y-Axis

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4. Set the other end of the X-axis cable track on the motor end of the M-Module. Secure the bracket using eight M3 screws. The Y-axis cable track should rest on top of the M-Module (see Figure 6-5).
5. Raise the Y-axis cable track and slide seven screw guides into the grooves as shown in Figure 6-6. Three screw guides should be placed in the groove closest to the Z-Theta combining bracket and four screw guides in the other groove.

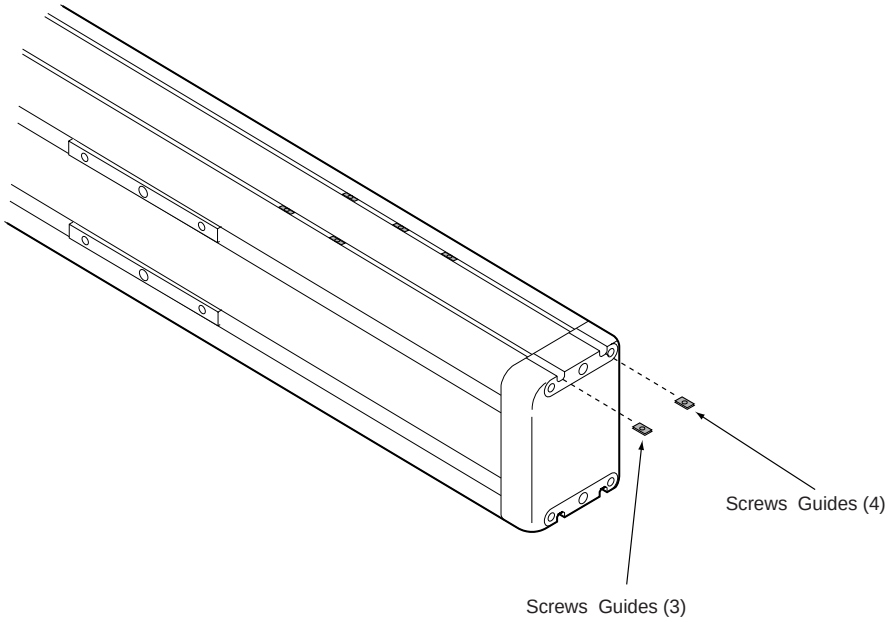


Figure 6-6. Y-Axis Cable Track Support Bracket Mounting Keys

6.2 Installing the Z-Theta Module

Removal of the Z-Theta Top Cover

1. Remove the three M5 Pan head screws on the top cover. Lift the cover straight up off the main body.

Attaching the Adept Z-Theta Module

1. Attach the unit to the M-Module slider with four M6 screws using an extended-length Hex wrench with a ball point as shown in Figure 6-7 and Figure 6-8.

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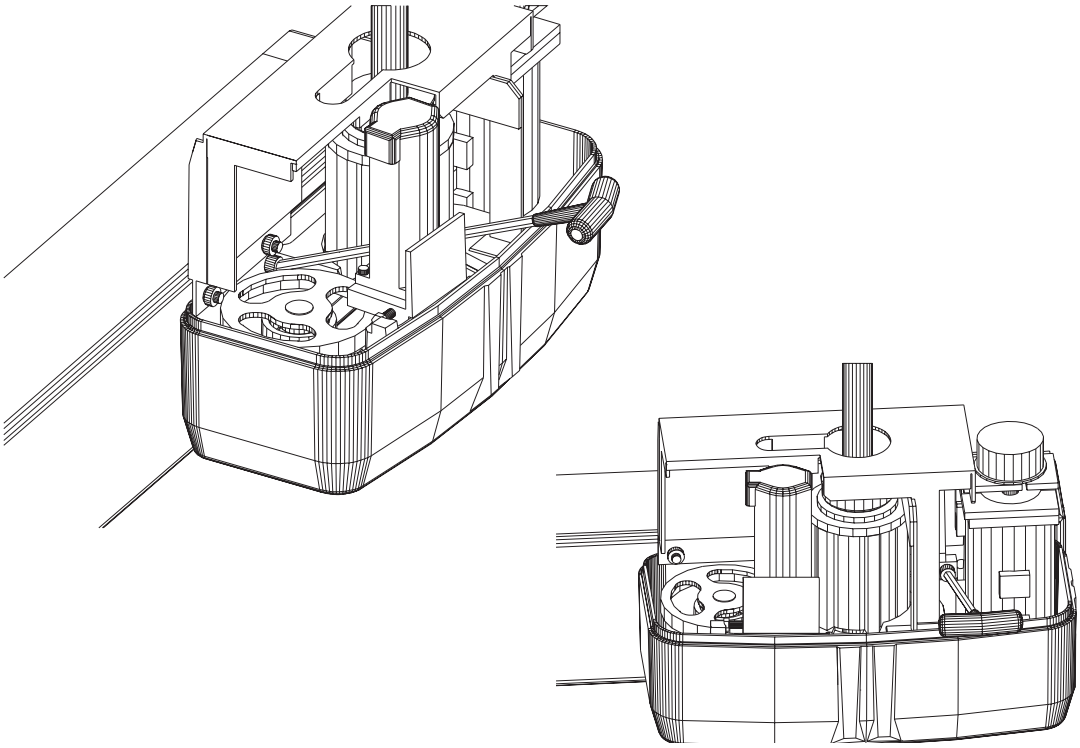


Figure 6-7. Z-Theta Mounting, Top Left, and Right Screws with Top Cover Removed

NOTE: The bottom two mounting screws are accessed from underneath the Z-Theta Module. Using the extended-length Hex wrench, tighten the unit to the M-Module.

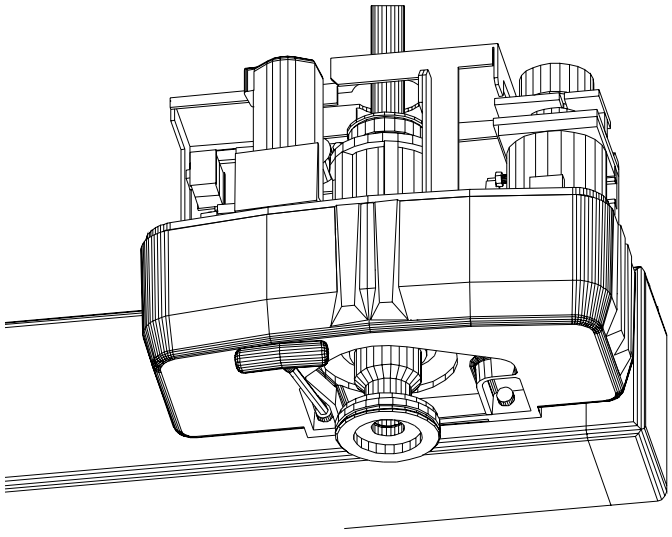


Figure 6-8. Attaching the Z-Theta to the Y-Axis

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2. Replace the top cover of the Z-Theta unit and secure it with the three M5 pan head screws which were removed earlier.
3. Fold the Y-axis cable track over and attach it to the rear of the Z-Theta unit with two M6 pan head screws (see Figure 6-10).

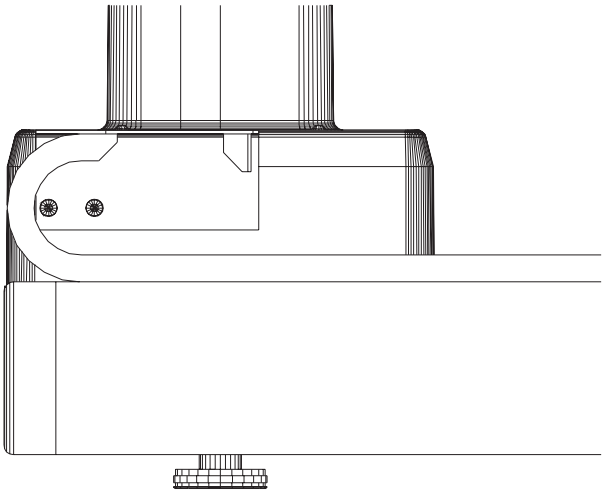


Figure 6-9. Attaching the Y-axis Cable Track to the Z-Theta Module

6.3 Installing the Cable Covers

NOTE: The middle cover is predrilled for the different size M-Modules. Align the proper set of holes for the length of the module being used.

1. Locate and remove the two pan head screws from the Y-axis cable track. These are attached to the cable tie down (see Figure 6-10).

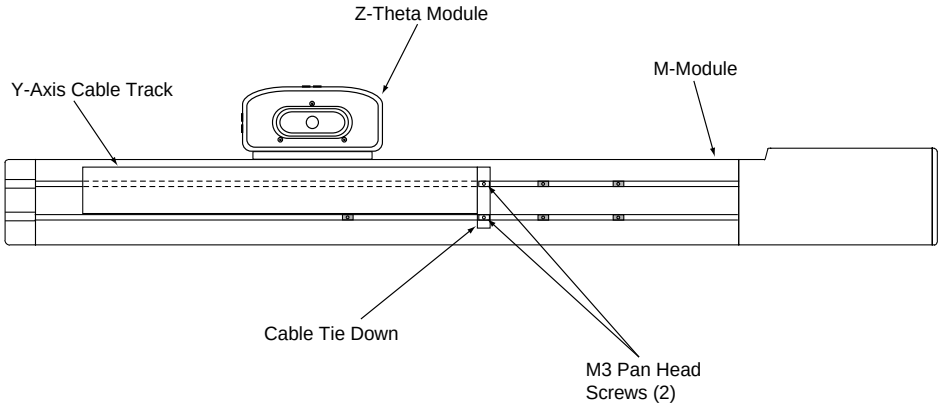


Figure 6-10. Y-axis Cable Track Screw Removal

2. Attach the bottom cover to the Y-axis cable track by one M3 x 6 screw at the back of the cover into one of the screw sliders (see Figure 6-11).

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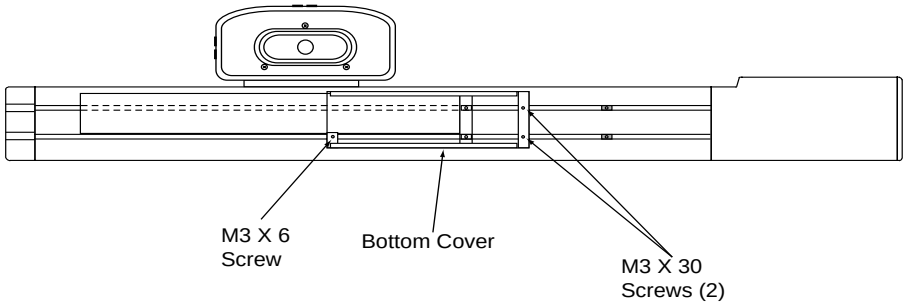


Figure 6-11. Bottom Cover Y-axis Cable Track

3. Align the middle cover holes with the bottom cover threaded holes and secure to the M-Module with two M3 x 30 screws at the front of the middle cover (see Figure 6-12). This will also secure the bottom cover to the Y-axis.

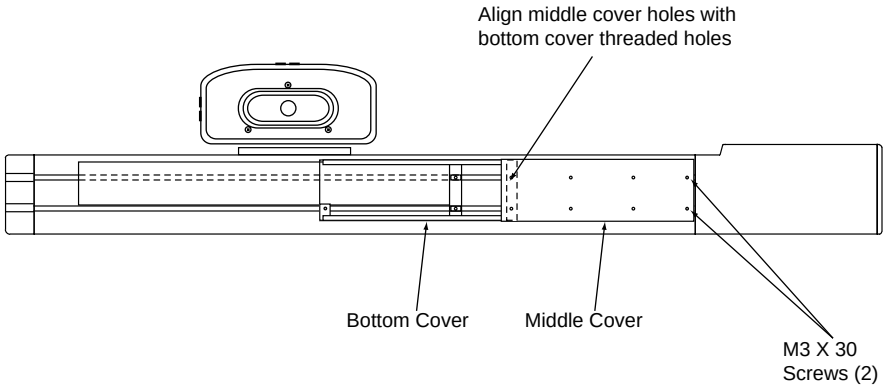


Figure 6-12. Alignment of the Cover Plates

4. Place the top cover over the bottom cover and secure with four M3 x 7 pan head screws (see Figure 6-13).

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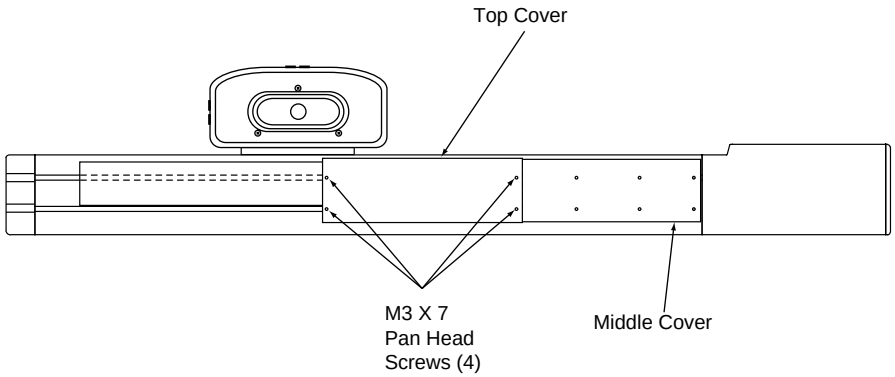


Figure 6-13. Securing the Cover Plates

6.4 AdeptCartesian Electrical Connections

When connecting the cables to the controller, ensure that all are connected to the proper connection.



WARNING: Improper connection of the cables could result in personal injury or damage to the equipment.

Table 6-2 includes all of the cable sets that are required for a standard AdeptCartesian robot.

Table 6-2. AdeptCartesian Cable Options

Cable	Part Number	Quantity
EJI to Amp Cable Assemble	10330-11140	1
Amp Break-out Cable	10400-00600	1
Module to RSC Box Cable (3m)	10400-07003	1
Arm Signal Cable	10861-01330	1
LMMV Interface Cable Set (3m)	10451-64103	1
DIO Cable Set	90330-01080	1

NOTE: The DIO Cable Set is required only if an optional DIO board is present in the controller.

Refer to Figure 6-14 and Figure 6-15 for the proper cable connections.

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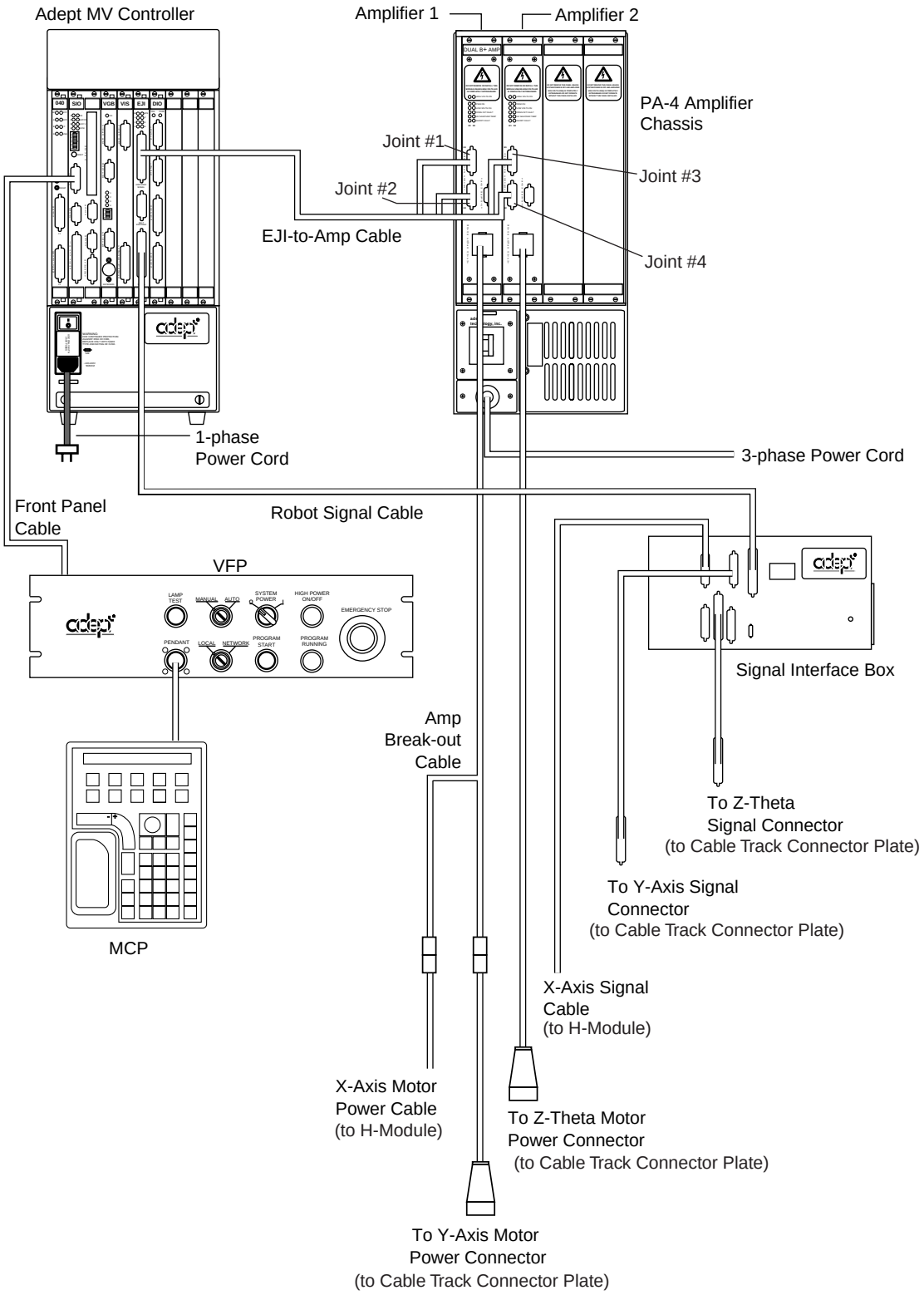


Figure 6-14. System Cable Layout

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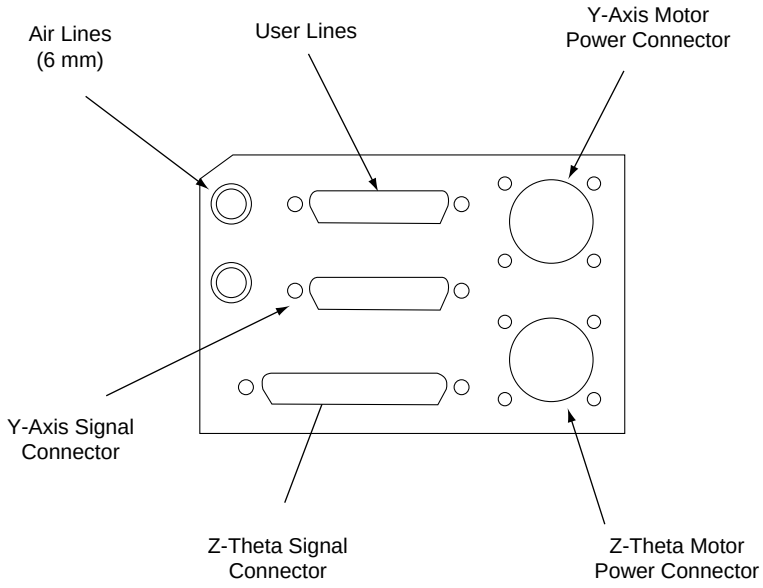


Figure 6-15. Cable Track Connector Plate

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7 Maintenance

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7.1 Initial Confirmation

Confirm the following before applying power:

1. Check that the main unit joint bolts are firmly tightened.
2. Move each axis to the stroke limit and verify that the module does not strike any obstacles.
   a. For the vertical axis, apply power, turn on the servo, and release the brake.
   b. Select manual control mode, then move the unit slowly by JOG operation.
   c. Check that the axis does not strike an obstacle.

   NOTE: See the instruction manual for the controller and ensure that the servo is on before releasing the brake.
3. Check the cables for correct connection.
   a. The same robot module connector is used regardless of motor output.
   b. Before supplying power, check that the controller's motor power output is connected to the proper module type as shown in Table 7-1.

Main Unit	Controller Output
H-Module	300W
M-Module	300W
S-Module	100W

Table 7-1. Module Power Output



WARNING: Improper connection may result in damage to the motor.

Upon completing this verification, proceed with test operation according to the procedures specified in the *AdeptModules Vol. 1 MV Controller Interface* manual.

7.2 Maintenance

To prevent accidents, observe the following precautions when inspecting or maintaining the unit:



WARNING: Turn off the power to the controller when personnel or tools are in the vicinity of the robot work area.

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WARNING: Do not disassemble or modify the unit except as instructed in this manual.

Daily Maintenance

Perform daily checks as shown in Figure 7-2.

Table 7-2. Daily Maintenance Checks

Check Points	Procedures and Specifications
Base fixing bolt	Check for looseness; tighten as necessary.
Work fixing bolt	See “Installation” for tightening torque.
Main Unit seal bolt	Remove dust.
Robot cable (Figure 7-1)	Check cap nut for looseness; tighten as necessary. Tightening torque: 7.5 to 9.0 N•m (77 to 92 kgf•cm) Check holder fixing bolt (M3) for looseness; tighten as necessary. Tightening torque: 1.47 N•m (15 kgf•cm) Check elbow fixing screw (M5) for looseness; tighten as necessary. Tightening torque: 1.47 N•m (15 kgf•cm) Check cable for deep scratches and damage; replace as necessary.
Controller cable	Check cable for deep scratches and damage; replace as necessary.

NOTE: No brush replacement is required because AC servo motors are used in this product.

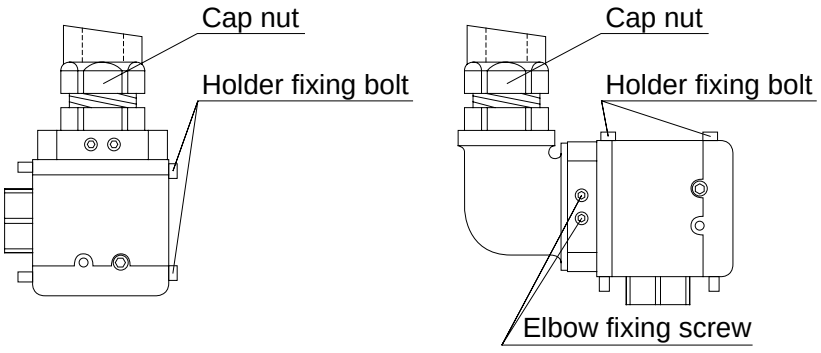


Figure 7-1. Robot Cable Maintenance Checks

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7.3 Modules Lubrication

Lubrication Schedule

Each Module should be lubricated after 5000 kilometers, 3,100 miles, or 16,400,000 feet of travel.

To calculate the estimated elapsed time in hours to achieve this module travel distance use the following equation:

$$\text{Number of Hours} = \frac{\text{Travel Distance to Lubricate} \times \text{Seconds / Cycle}}{\text{Travel Distance / Cycle} \times 3600 \text{ seconds / hour}}$$

For example, if a module performs a 2-meter travel in 4 seconds, the recommended number of elapsed hours between lubrication is:

$$\text{Number of Hours} = \frac{5{,}000{,}000 \text{ meters} \times 4 \text{ seconds / cycle}}{2 \text{ meters / cycle} \times 3600 \text{ seconds / hour}} = 2{,}778 \text{ hours}$$

2,778 hours could translate to a different lubrication interval (in weeks) depending on the production schedule of the modules equipment.

Production Schedule	1 shift / day 5 days / week 40 hours / week	2 shifts / day 6 days / week 96 hours / week	3 shifts / day 7 days / week 168 hours / week
Lubrication Interval	70 weeks	29 weeks	17 weeks

The table below provides an estimated lubrication schedule (in actual production weeks) based on the length of the module and an assumption of the travel distance and time required to perform the cycle. If your system includes two or more modules, all modules should be lubricated at the same time and the time should be determined by the module that requires the most frequent lubrication.

Table 7-3. Lubrication Schedule

Module Stroke Length (mm)	Estimated Module travel distance (meters)	Cycle time (seconds)	Total number of hours (hours)	Lubrication interval for 1 shift/day 5 days/week 40 hrs/week (weeks)	Lubrication interval for 2 shift/day 6 days/week 96 hrs/week (weeks)	Lubrication interval for 3 shift/day 7 days/week 168 hrs/week (weeks)
130	0.13	1.0	10,684	267	111	64
230,250	0.24	1.5	8,680	217	91	52
300,330,350	0.325	2.0	8,550	214	89	51
400,430,450	0.425	2.5	8,170	204	85	49

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Table 7-3. Lubrication Schedule (Continued)

500,530,550,600	0.55	3.0	7,576	189	79	45
750,800	0.78	3.5	6,232	156	65	37
950,1000,1200	1.0	4.0	5,555	139	59	33
1400 to 2000	1.4	4.5	4,464	112	47	27

Lubrication Grease

For standard non-cleanroom modules (module part numbers that begin with 90400-xxxxx), Shell Alvania No. 2 grease is recommended. Adept recommends that the customer purchase this grease from a third party. Adept does not offer this grease for the modules product. An alternative grease that may be more readily available is Dow Corning BR2 Plus Multi-Purpose EP grease.

For cleanroom modules (module part numbers that begin with 90401-xxxxx) a special cleanroom grease is required. This grease is supplied by Adept Technology in single 50 cc tubes. The Adept part number is 90401-04029 . Please contact Adept Customer Service to order.

Grease Adaptor Nozzle

A grease nozzle for the AdeptModules is available from Adept Technology (part number 90400-04100). This nozzle does not fit over the 3.5mm fitting, but must be pressed against the fitting to make a seal.

Applying grease through the fitting lubricates both the ball screw assembly and the linear bearing.

Lubrication Procedures

1. Remove the plastic black circular cap(s) from the module. The cap is approximately 10 mm (0.5") diameter.
   - The H-Module has two black caps located on each side of the module at the end of the module opposite the motor.
   - The M-Module has a single black cap located on the same side of the module as the cable connections and near the motor end of the module.
   - The S and Sz-Modules have a single black cap located on the same side as the motor housing at the end of the module opposite the motor.
2. Move the module slider until the grease nipple(s) can be seen through the access hole(s).
   - The slider of the H-Module must be moved to the end of the module travel.
   - The slider of the M-Module must be moved to a position 10 mm (0.5") from the motor end.
   - The slider of the S- and Sz-Module must be moved to a position 35 mm (1.5") from the end opposite the motor.

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3. Fill the module with the appropriate amount of grease.
   - The H-Module requires 20 cc (2/3 oz.) of grease. It is recommended to fill each side with approximately 10 cc (1/3 oz.).
   - The M-Module requires 10 cc (1/3 oz.).
   - The S- and Sz-Module require 2.0 cc (0.1 oz.).
4. Replace the black plastic cap(s) on the modules.

7.4 Pins, Connectors, and Screws

Connector Pins and Inserter/Extractor Tools

The modules and spare motors are supplied with JAE connectors with crimp-style pins. If these pins need to be repaired or replaced, additional pins and an inserter/extractor tool are required.

Description	JAE Part Number
Encoder Pins	030-51906-800
Motor Pins	030-51928-800

The motor pins are the larger of the two pins. Adept Technology-San Jose has a limited supply of these pins to send to customers upon request. Please contact Adept Technology Customer Service.

In order to replace encoder or motor pins an inserter/extractor tool is required.

Description	Part Number	Color
Encoder Pin Inserter/Extractor Tool	JIET-D*C-20	Red/White
Contact JAE directly for this Inserter/Extractor Tool JAE Electronics 142 Technology Drive Irvine, CA 92718-2401 Phone (714) 753-2600 Fax (714) 753-2699		

A different tool is required for replacing motor pins.

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Description	Part Number	Color
Motor Pin Inserter / Extractor Tool	CIET-16	Blue / White
This tool is provided with each spare motor shipped by Adept. Contact JAE for additional tools.		
Another source for this tool is Aiconics USA. The Aiconics part number is M81969 14-03. Contact the following company for this Aiconics tool: Connector MicroTooling Systems 14500 Trinity Blvd. Suite 110 Fort Worth, Texas 76155 Phone (817) 283-4882 Fax (817) 354-0790		

DDK Compatible Connectors

JAE connectors have 12- to 14-week lead times. An alternative source for JAE compatible connectors is DDK Electronics. DDK can generally offer much shorter lead times. The DDK JM Series connectors are compatible with JAE SRCD connectors. However, the DDK connectors are solder style connectors while the JAE connectors are crimp-style.

Contact DDK directly for these connectors:

DDK Electronics, Inc. (USA)
3001 Oakmead Village Drive
Santa Clara, CA 95051
Phone (408) 980-8344
Fax (408) 980-9750

DDK Electronics (Europe), LTD
Grange Lodge, Market Square
Westerham, Kent TN16 1AR, U.K.
Phone 0959-5-61224
Fax 0959-5-61034

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JAE Connectors and DDK Connector Cross Reference List

The following table lists the compatible DDK connectors.

Table 7-4. DDK Connectors

Part No.	Cable	JAE Connector	DDK Connector
90400-0300x (x = 3, 6, 9, …)	Controller to Module Cable (Module End)	SRCD6A21-16SC-A-FO	JMSP2116F
90400-0300x (x = 3, 6, 9, …)	Controller to Module Cable (Module End)	SRCD6A21-10SC-A-FO	JMSP2110F
90400-03100	Cable Inside cable track (Cable end)	SRCD1A21-16PC-A-FO	JMCR2116M
90400-03100	Cable Inside cable track (Cable end)	SRCD1A21-10PC-A-FO	JMCR2110M
All Modules	Flanged Connector inside Module unit	SRCD2A21-16PC-A-FO	JMR2116M
All Modules	Flanged Connector inside Module unit	SRCD2A21-10PC-A-FO	JMR2110M

Robot Cable Mounting Screws

The Robot Cables require a special metric mounting screw of size M3 x 57. These screws cannot be purchased “off-the-shelf” in the United States. Adept Technology can provide these screws to customers at no charge. Please contact Adept Customer Service to obtain these screws.

Periodic Maintenance

Grease Refill

Replenish the grease every 5000 km of travel. This is assuming the module is in a clean environment. In other than a clean environment greasing will need to be done more frequently than every 5000 km.

Grease: Shell Alvania No.2

Refill Method for an H-Module

1. Position the slider to the counter motor stroke end (away from the motor).
2. Remove the black cap on one side of the frame with a standard screw driver or similar tool.

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3. Locate the grease nipple inside the frame, and deposit approximately 20 cc of grease with a grease gun (Figure 7-2).

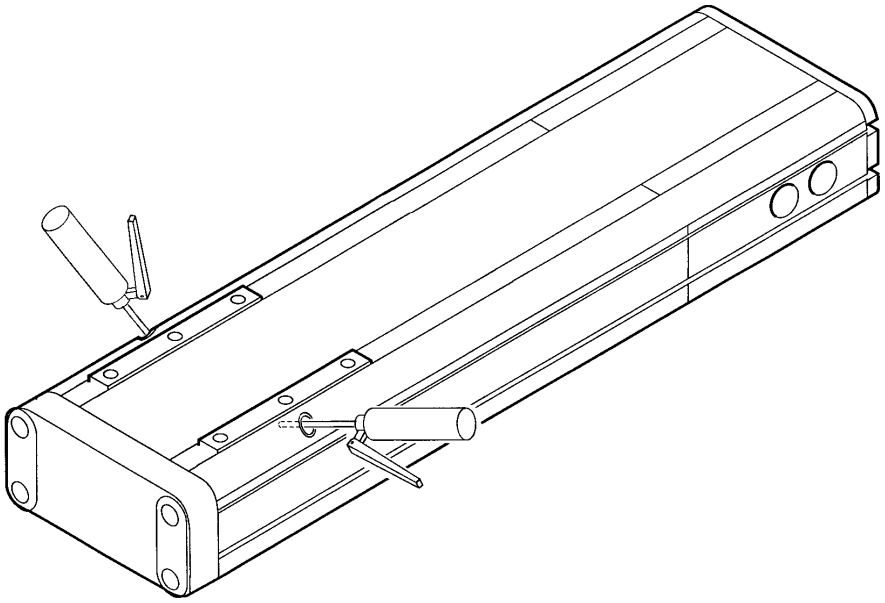


Figure 7-2. Greasing an H-Type Module

4. Replace the cap flush with the frame.
5. Repeat steps 2 through 4 for the opposite side.

Refill Method for an M-Module

1. Position the slider to within 10 mm of the motor side stroke end.
2. Remove the black cap on the side of the frame with a standard screwdriver or similar tool.

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3. Locate the grease nipple inside the frame, and deposit approximately 10 cc of grease with a grease gun (Figure 7-3).

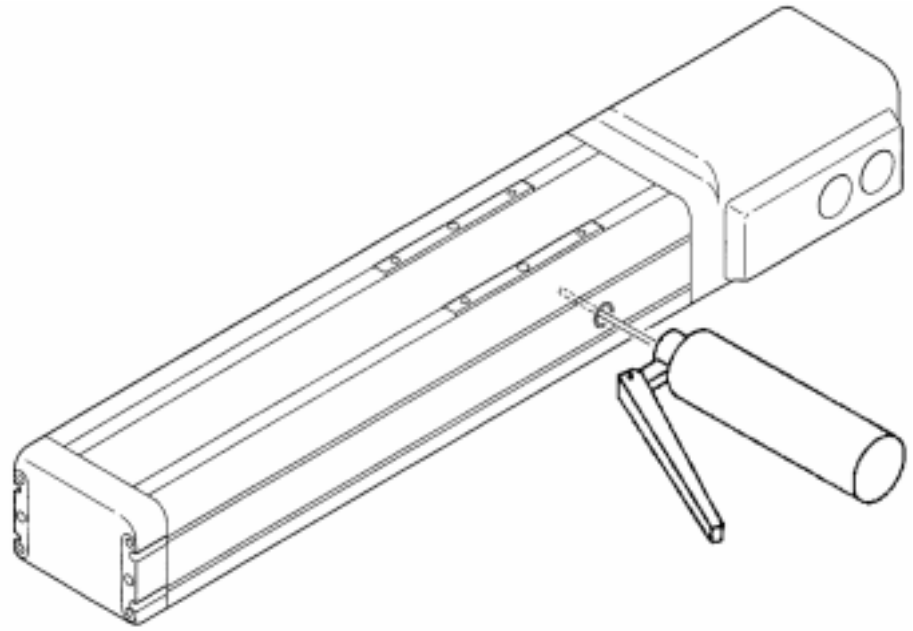


Figure 7-3. Greasing an M-Type Module

4. Replace the cap flush with the frame.

Refill Method for an S-Module

1. Position the slider to within 35 mm of the counter motor side stroke end (away from the motor).
2. Remove the black cap on the side of the frame with a standard screwdriver or similar tool.

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3. Locate the grease nipple inside the frame, and deposit approximately 2 cc of grease with a grease gun (Figure 7-4).

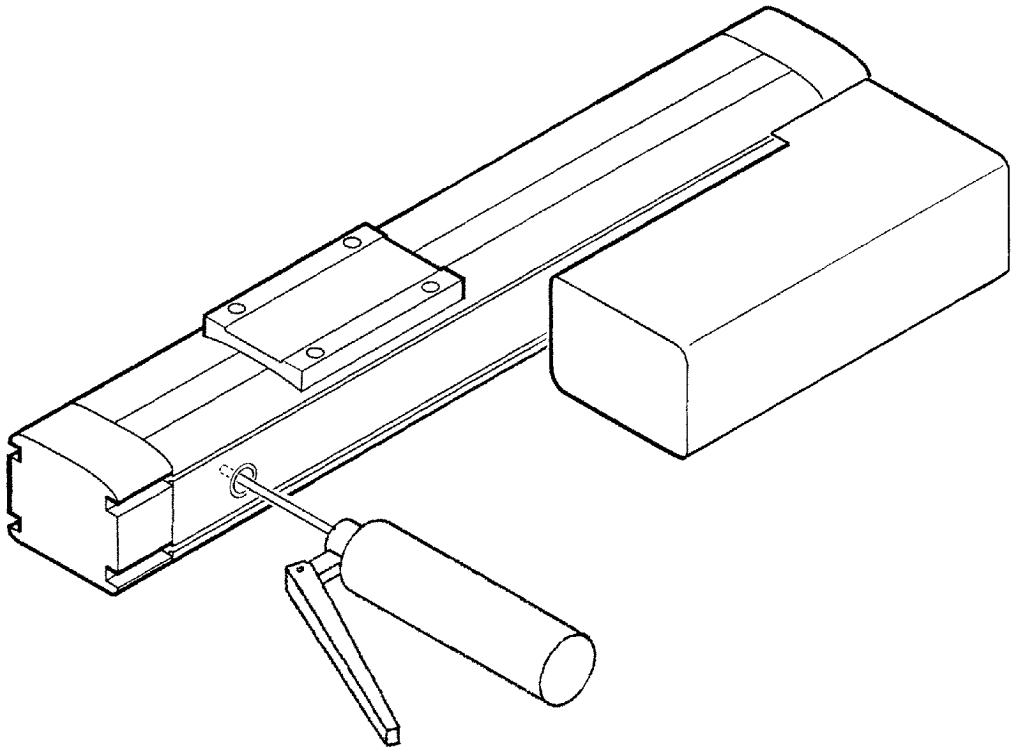


Figure 7-4. Greasing an S-Type Module

4. Replace the cap flush with the frame.

EXC/EXA Controller Back-up Batteries

Replace the EXC/EXA controller back-up batteries every two years.

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8.1 Specifications

Specifications

Standard Modules

		H-Module	M-Module	S-Module	Sz-Module
Stroke (mm)		300/400/500/ 600/800/1000	250/350/450/ 550/750/950	130/230/330/ 430/530	130/230
Maximum speed (mm•s)		1200	1200	1200[a]	600
Horizontally transportable load (kg)		60	40	20	15[b]
Rated thrust force (N)[c]		300	300	120[d]	240
Transportable moment[f]	Roll (N•m)[e]	600	70	27	27
	Pitch (N•m)	400	120	10	10
	Yaw (N•m)	350	120	10	10
Repeatability (mm)		±0.010	±0.010	±0.010	±0.010
Motor output (W)		300	300	100	100[g]
Ball screw lead (mm)		20	20	20[h]	10
Motor mount position		Direct mount	Direct mount	Right side	Left side

[a] The maximum speed for 130 mm and 230 mm stroke models is 600 mm per second
[b] Vertically transportable load
[c] 1N @ 0.102 kgf
[d] The rated thrust force for 130 mm and 230 mm stroke models is 240 N
[e] 1N•m @ 0.102 kgf•m
[f] The rate of acceleration affects the maximum transportable moment
[g] With brake
[h] The lead for 130 mm and 230 mm stroke models is 10 mm

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Transportable Load of Moving Axes

Table 8-1. Horizontal Axis Transportable Load

H-Module		M-Module		S-Module	
Stroke (mm)	Transportable load W(kg)	Stroke (mm)	Transportable load W(kg)	Stroke (mm)	Transportable load W(kg)
300	40	250	25	130	3
400	40	350	20	230	1.4
500	40	450	16		
600	36	550	12		
800	25	750	7		
1000	17	950	3		

Table 8-2. Vertical Axis Transportable Load

Sz-Module	
Stroke (mm)	Transportable load W(kg)
130	10
230	9

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8.2 Module Dimensions

H Module

Ref. number	Stroke (mm)	L (mm)	S A (mm)	S B (mm)	Weight (kg)
90400-10100	1000	1440	800	540	34
90400-10080	800	1240	600	440	29
90400-10060	600	1040	400	340	25
90400-10050	500	940	300	290	23
90400-10040	400	840	200	240	21
90400-10030	300	740	100	190	19

Note: In thes figure the tap hole on the left that is marked with an asterisk is 8-M8, depth 12, for the XY-HRS040-H201.

Mounting bracket kit (sold separately)

Ref. number:	90400-12**0

Note: Each kit has one bracket. We recommend that you use 2 kits for models with a stroke of 600 mm or less, and 3 kits for models with a stroke of 800 mm or more.

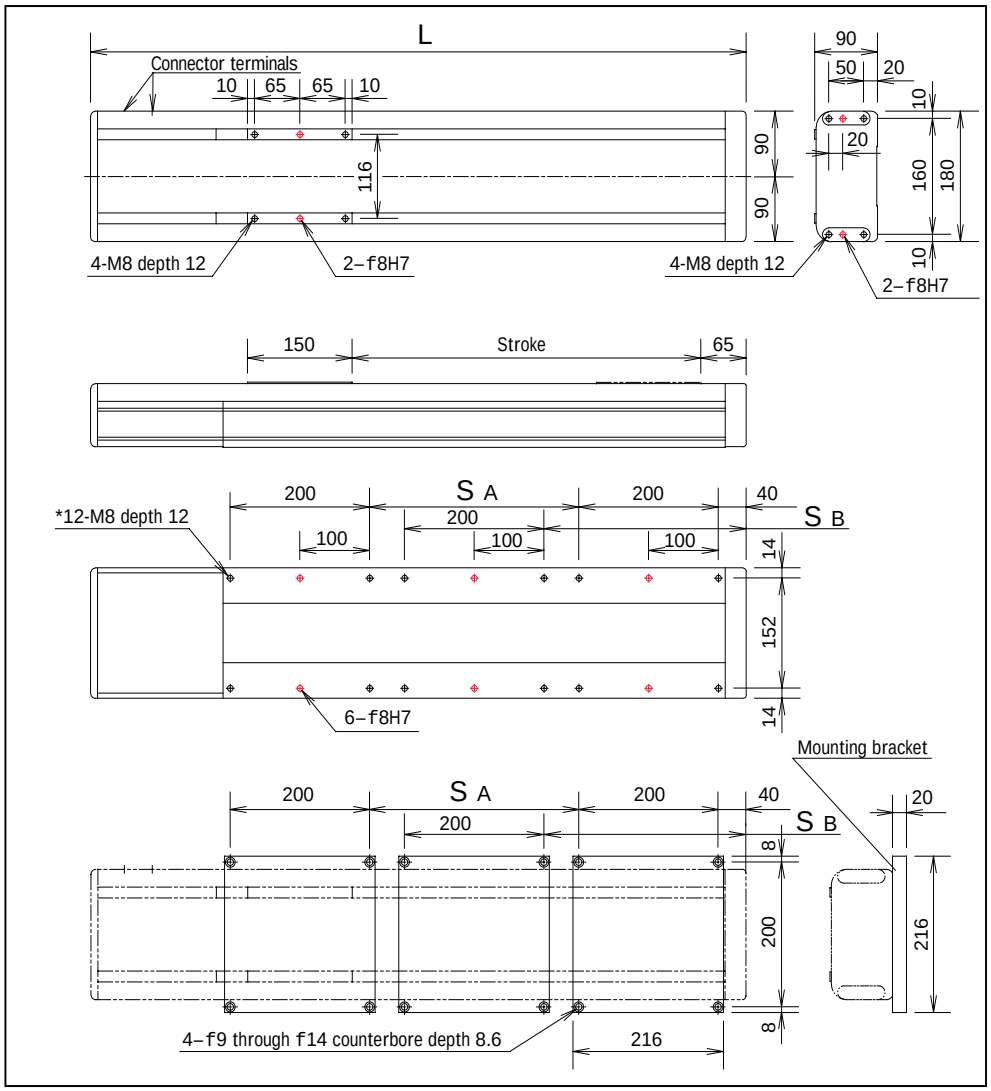


Figure 8-1. H Module

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M Module

Ref. number	Stroke (mm)	L (mm)	S A (mm)	S B (mm)	Weight (kg)
90400-20095	950	1420	770	527	20.0
90400-20075	750	1220	570	427	17.0
90400-20055	550	1020	370	327	14.5
90400-20045	450	920	270	277	13.5
90400-20035	350	820	170	227	12.5
90400-20025	250	720	70	177	11.5

Mounting bracket kit (sold separately)

Ref. number:	90400-01200

Note: Each kit has one bracket. We recommend that you use 2 kits for models with a stroke of 550 mm or less, and 3 kits for models with a stroke of 750 mm or more.

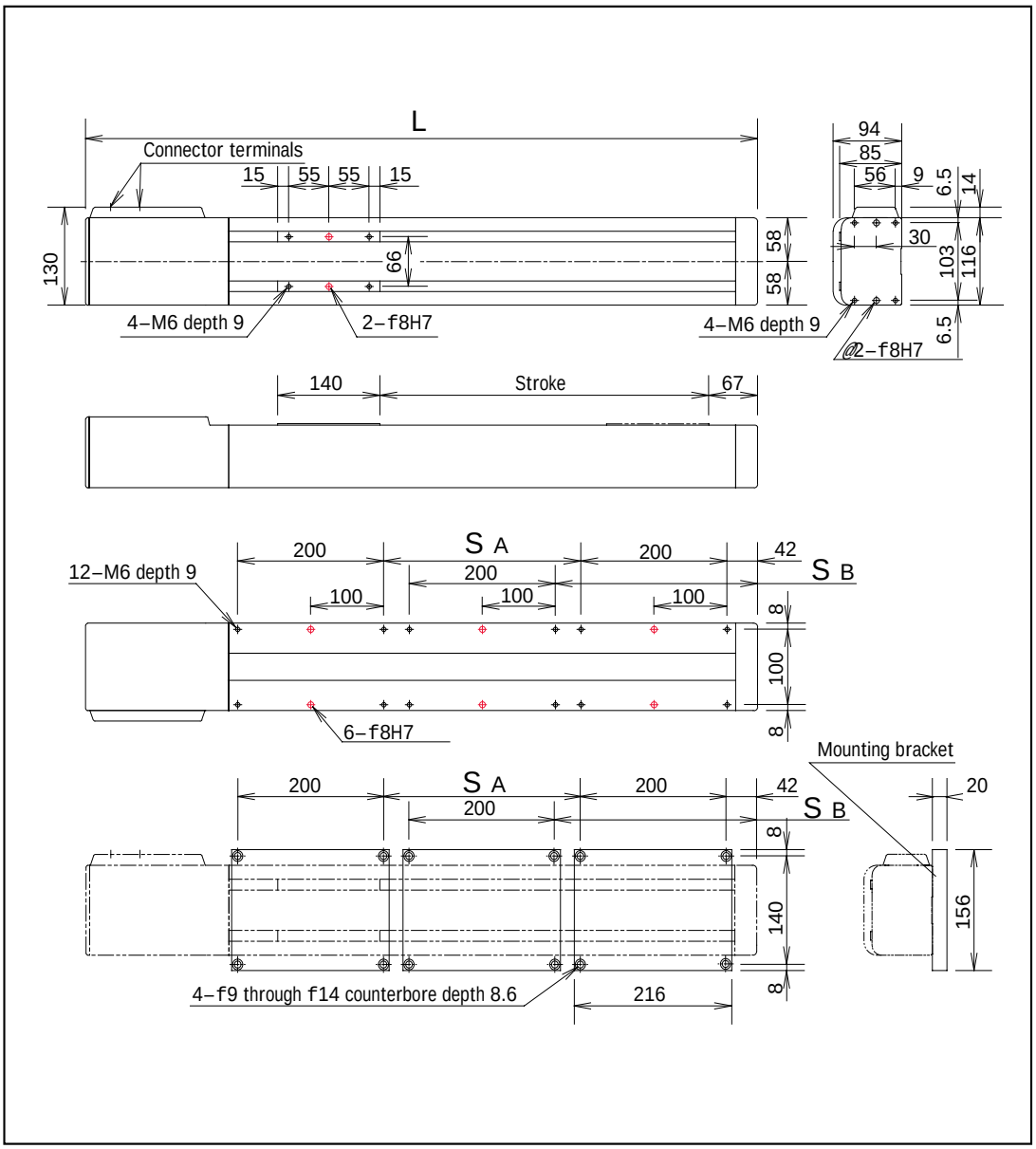


Figure 8-2. M Module

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S Module

Ref. number	Stroke (mm)	L (mm)	S A (mm)	S B (mm)	S C (mm)	Weight (kg)
90400-30053	530	760	460	330	560	8.0
90400-30043	430	660	360	280	460	7.3
90400-30033	330	560	260	230	360	6.6
90400-30023	230	460	160	180	260	6.0
90400-30013	130	360	60	130	160	5.3

Mounting bracket kit (sold separately)

Ref. number:	90400-01300

Note: Each kit has one bracket. We recommend that you use 2 kits.

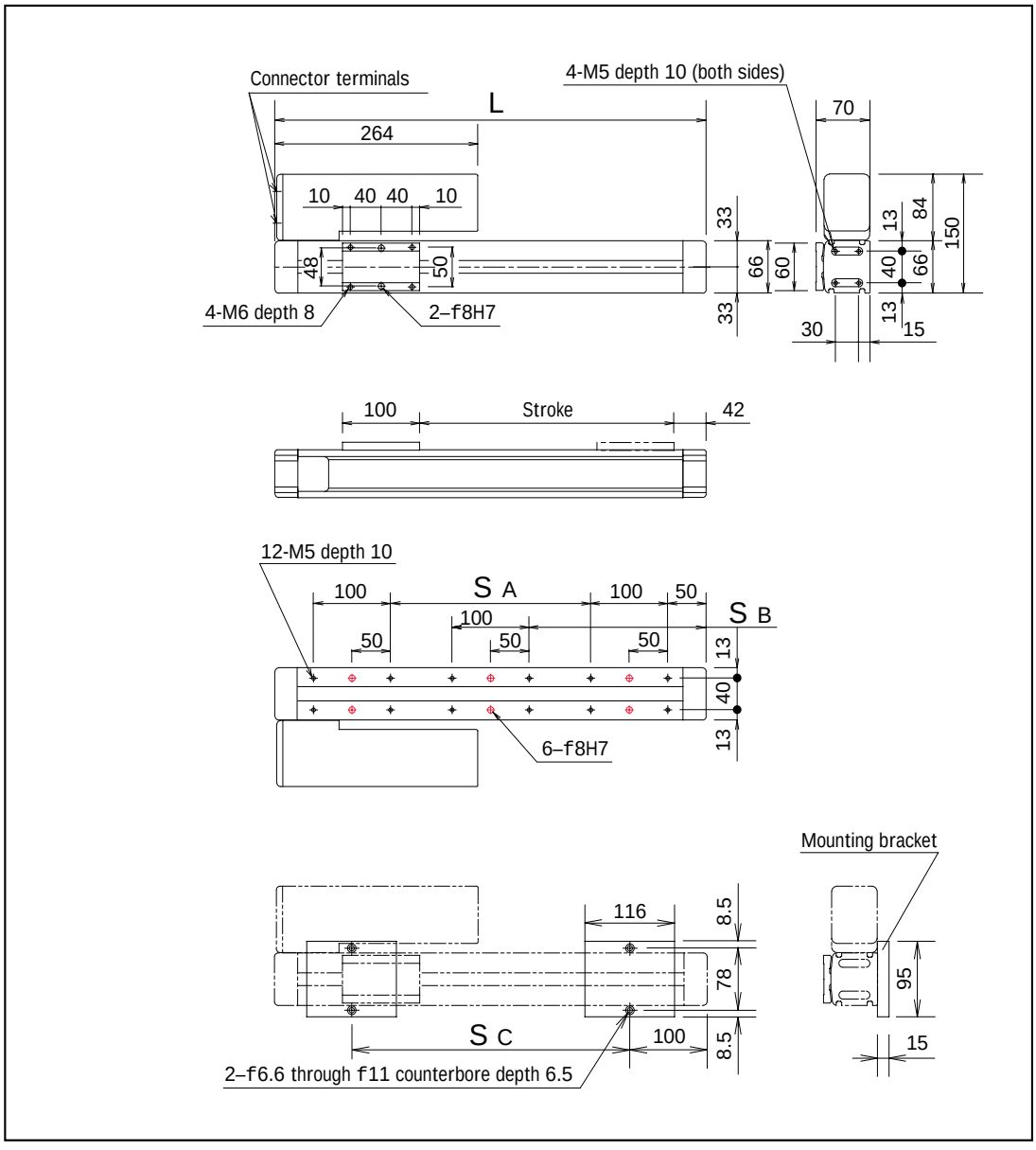


Figure 8-3. S Module

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Sz Module

Ref. number	Stroke (mm)	L (mm)	S A (mm)	S B (mm)	Weight (kg)
90400-40023	230	460	160	180	6.2
90400-40013	130	360	60	130	5.5

Note: You can use the same type of mounting bracket as for the S-module horizontal axes.

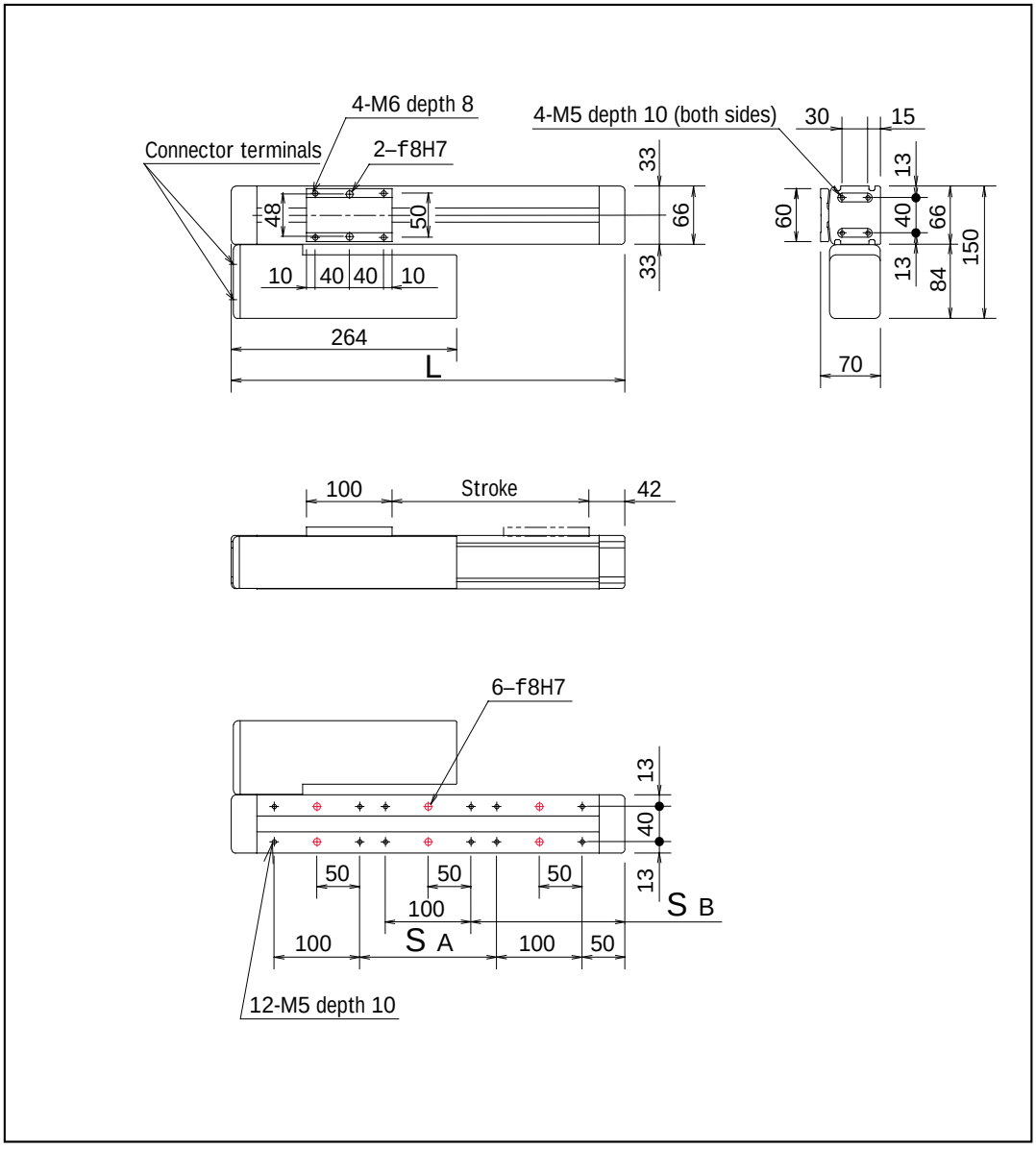


Figure 8-4. Sz Module

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Z-theta Module

Part number	Vertical Stroke (mm)	Rotation (deg)	Weight (kg)
30451-51000	± 210°	360	8.0

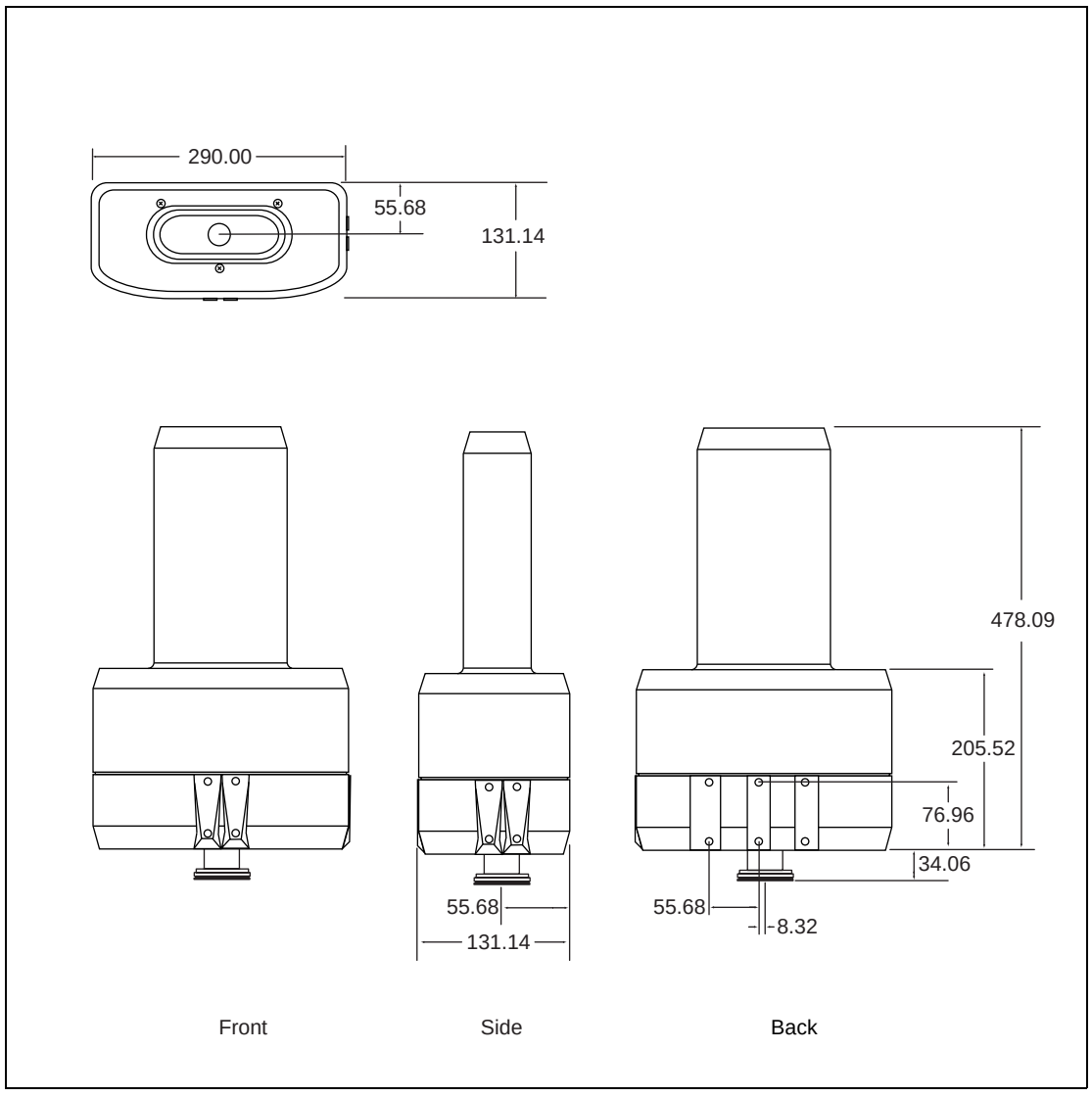


Figure 8-5. Z-Theta Module

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8.3 Bracket Dimensions

H-Module Mounting Bracket

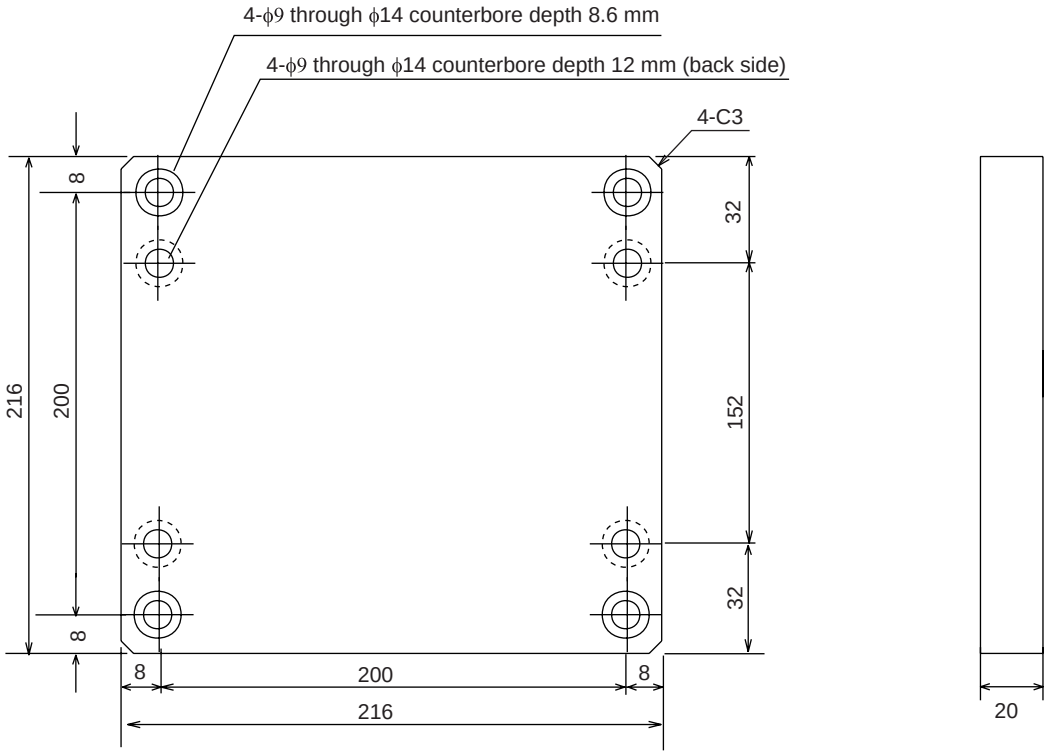


Figure 8-6. H-Module Mounting Bracket

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M-Module Mounting Bracket

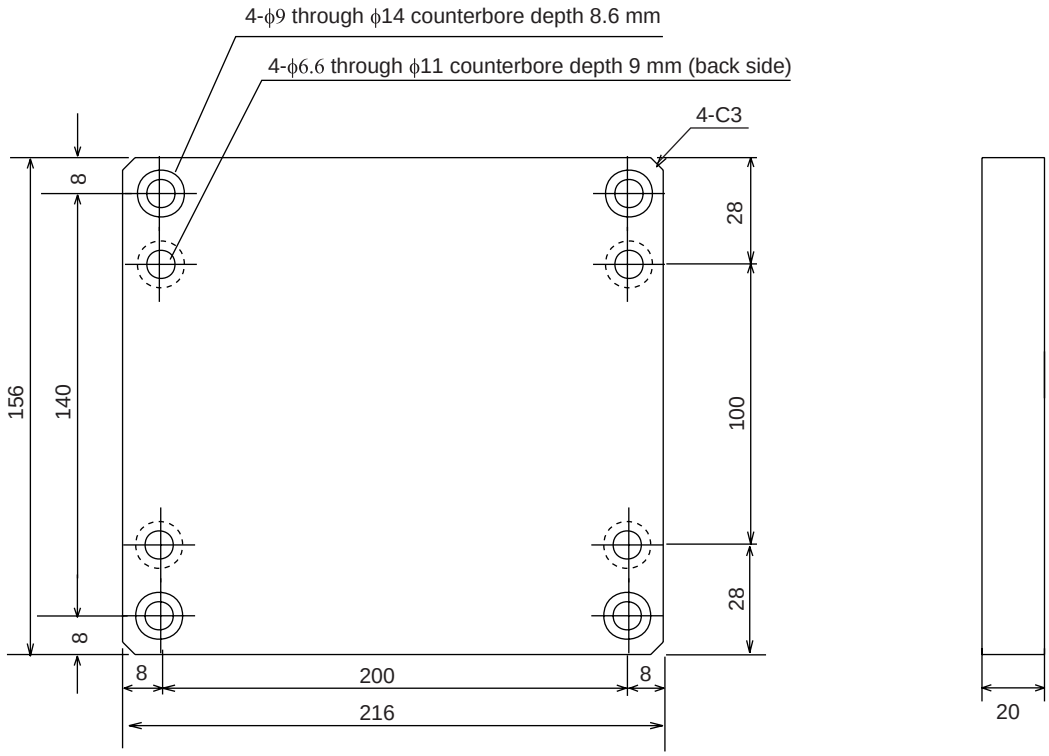


Figure 8-7. M-Module Mounting Bracket

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S/Sz-Module Mounting Bracket

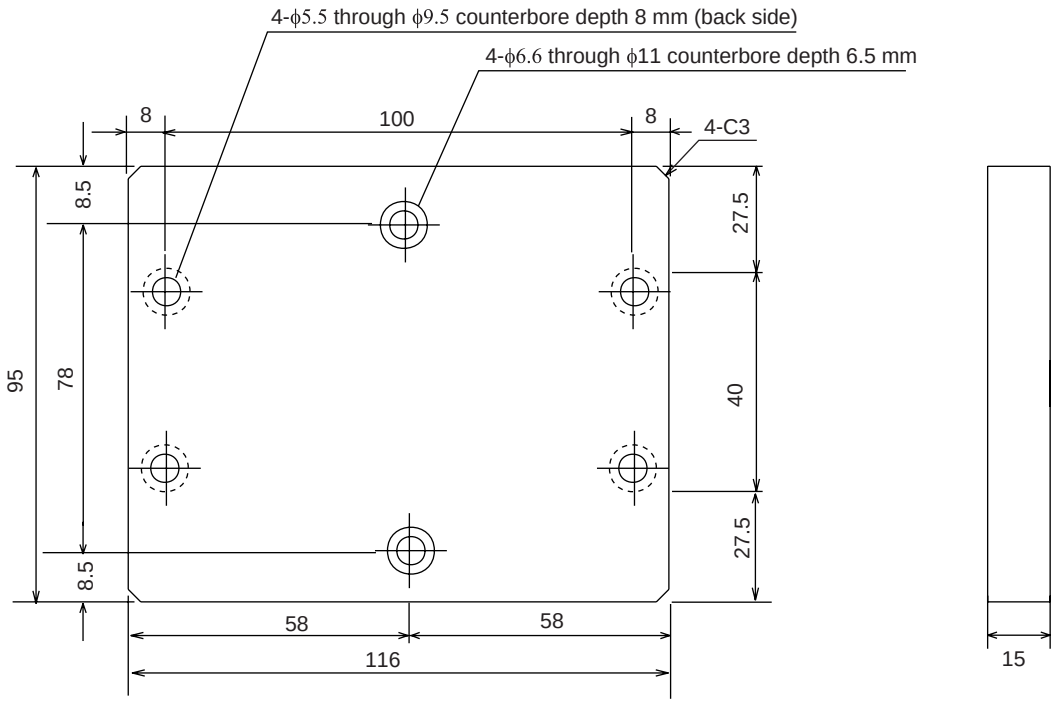


Figure 8-8. S/Sz-Module Mounting Bracket

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Gantry Support Bracket

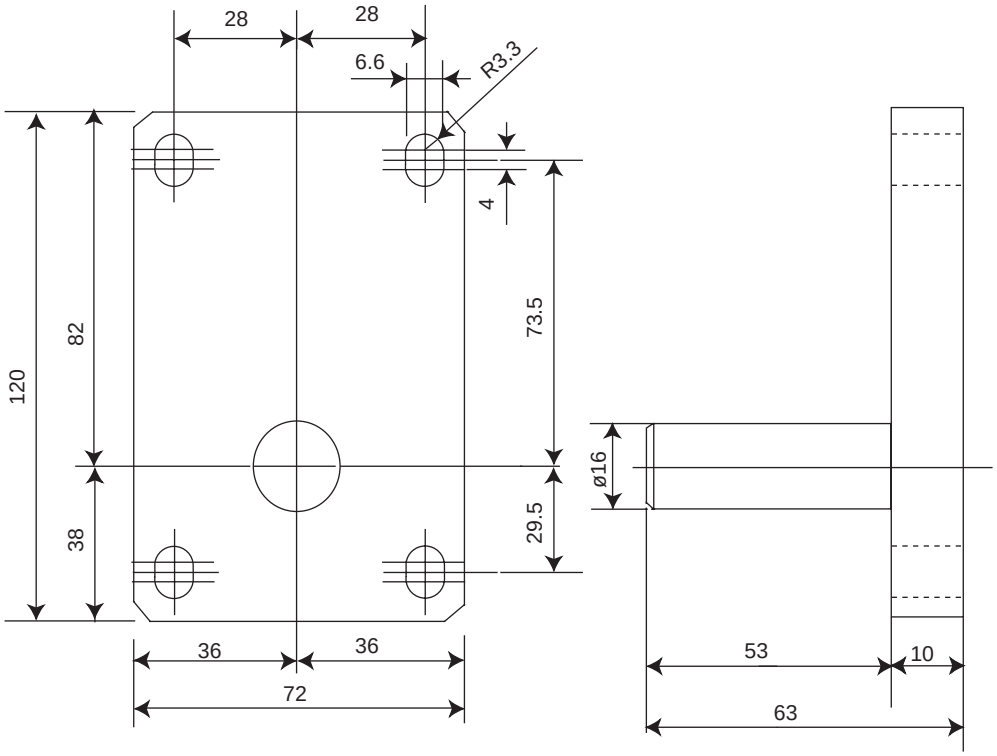


Figure 8-9. Gantry Support Bracket

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CMS Bracket

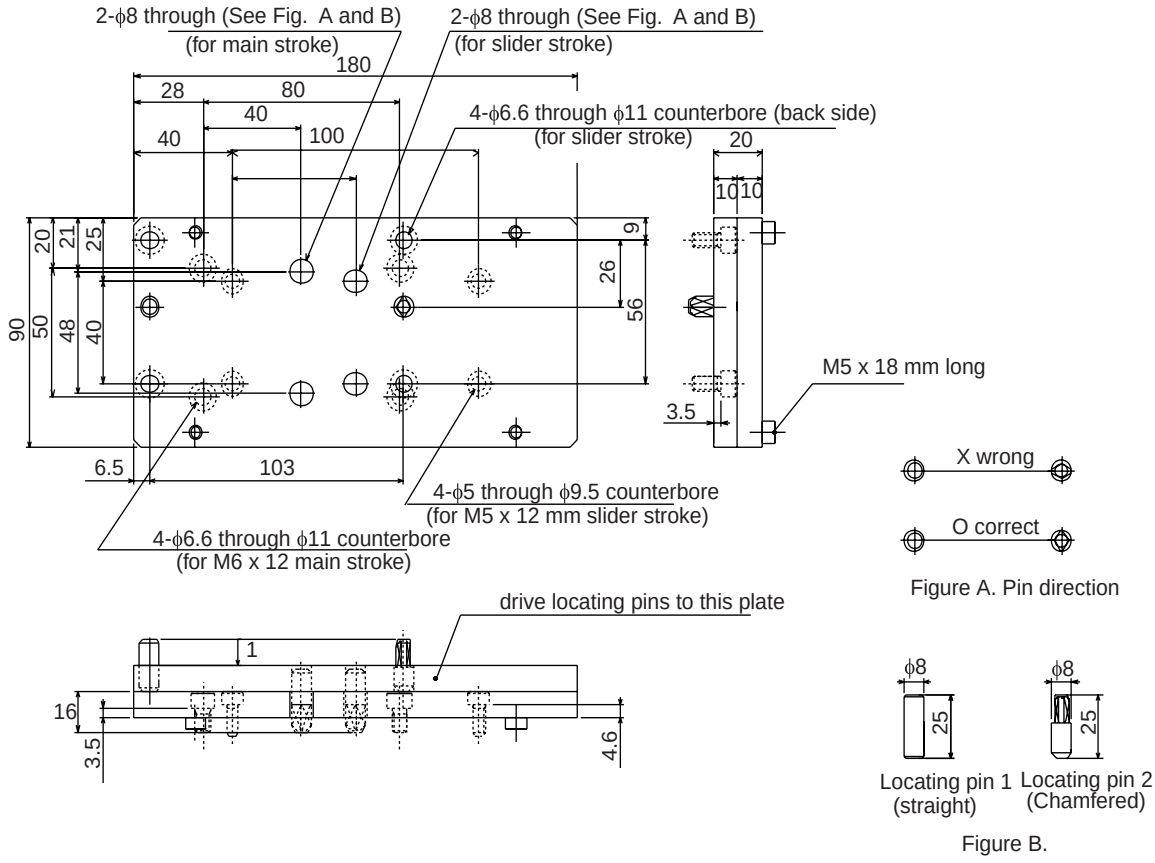


Figure A. Pin direction

Figure B.

Figure 8-10. CMS Type Bracket

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DHM Bracket

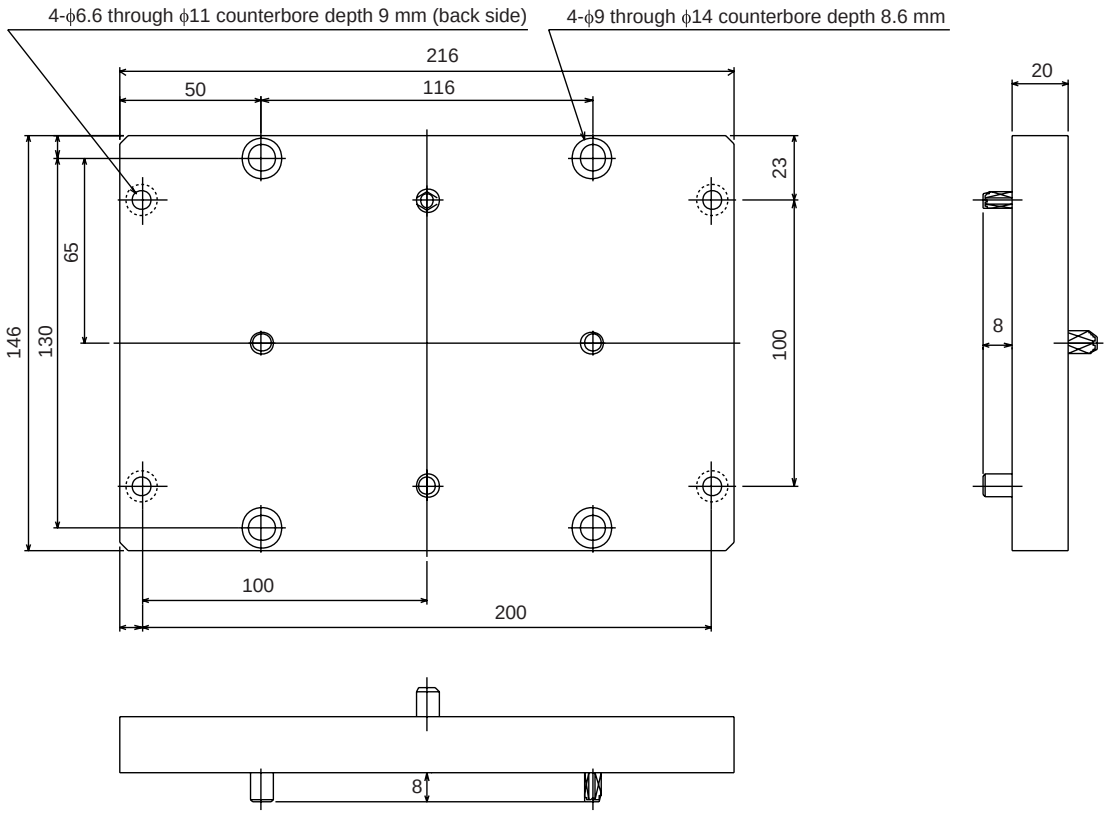


Figure 8-11. DHM Type Bracket

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DMM Bracket

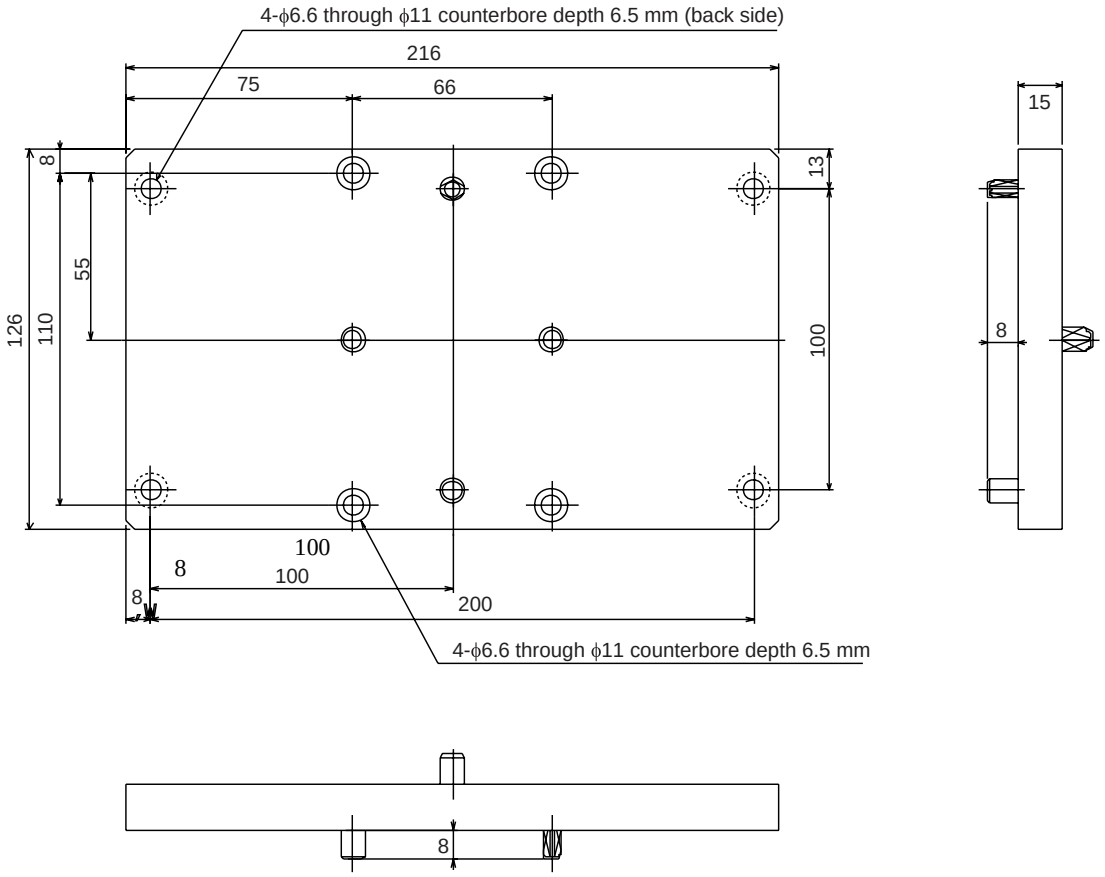


Figure 8-12. DMM Type Bracket

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DSS Bracket

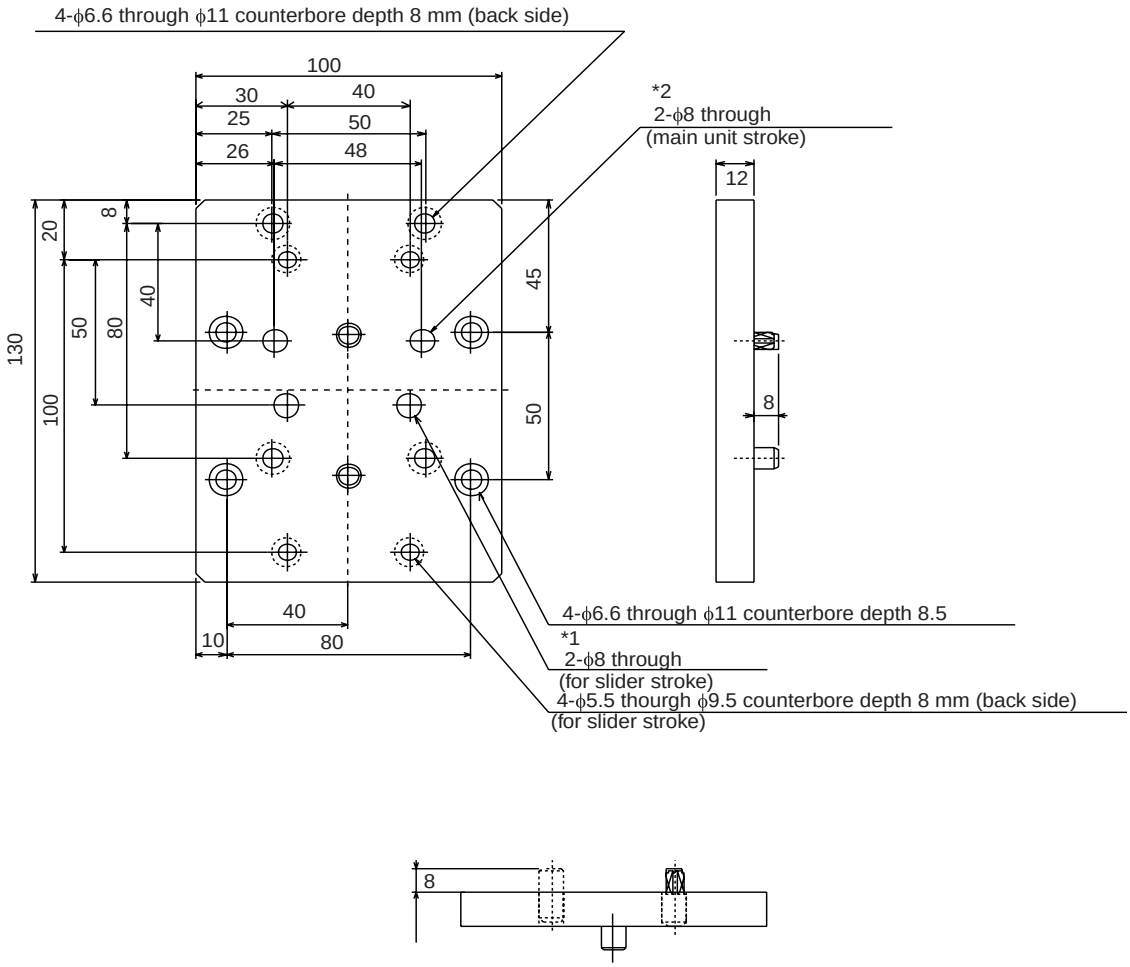


Figure 8-13. DSS Type Bracket

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D-Type Combination End Plate

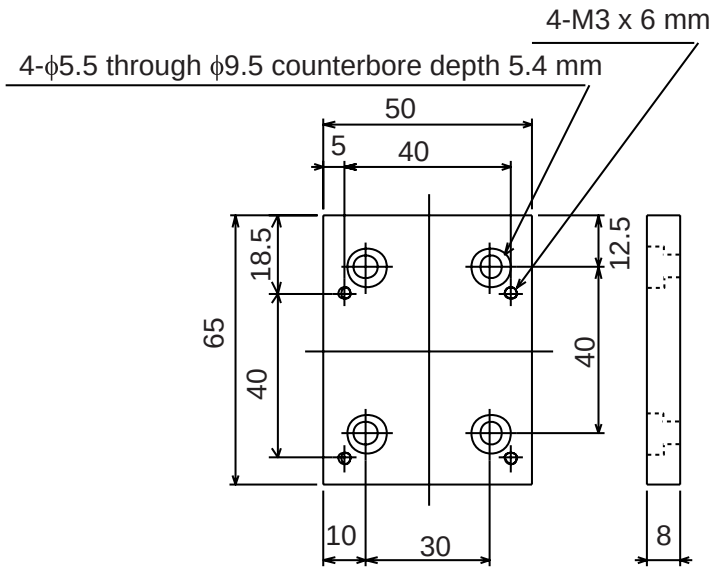


Figure 8-14. D-Type End Plate

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DMS Bracket

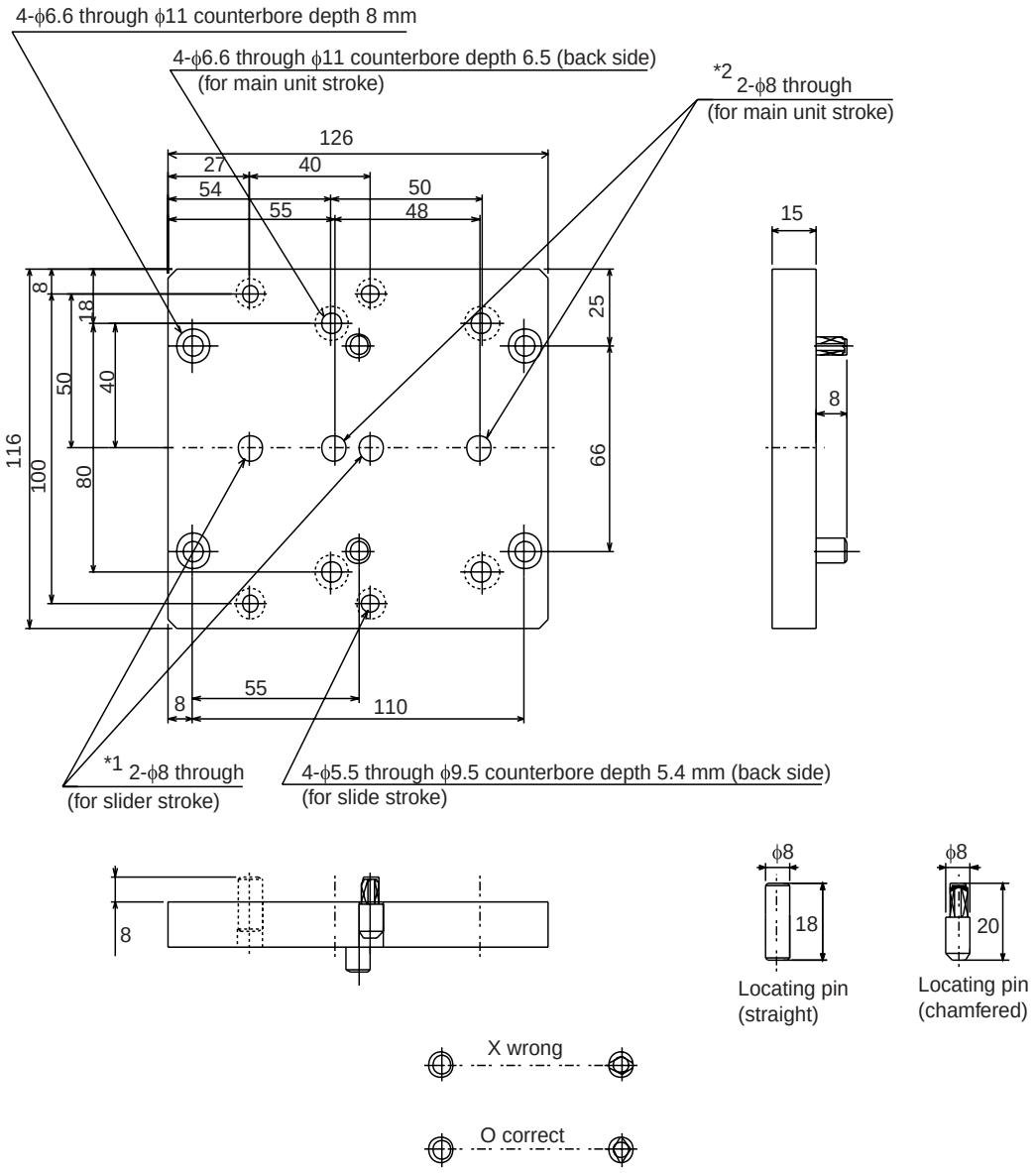


Figure 8-15. DMS Bracket

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GHM Bracket

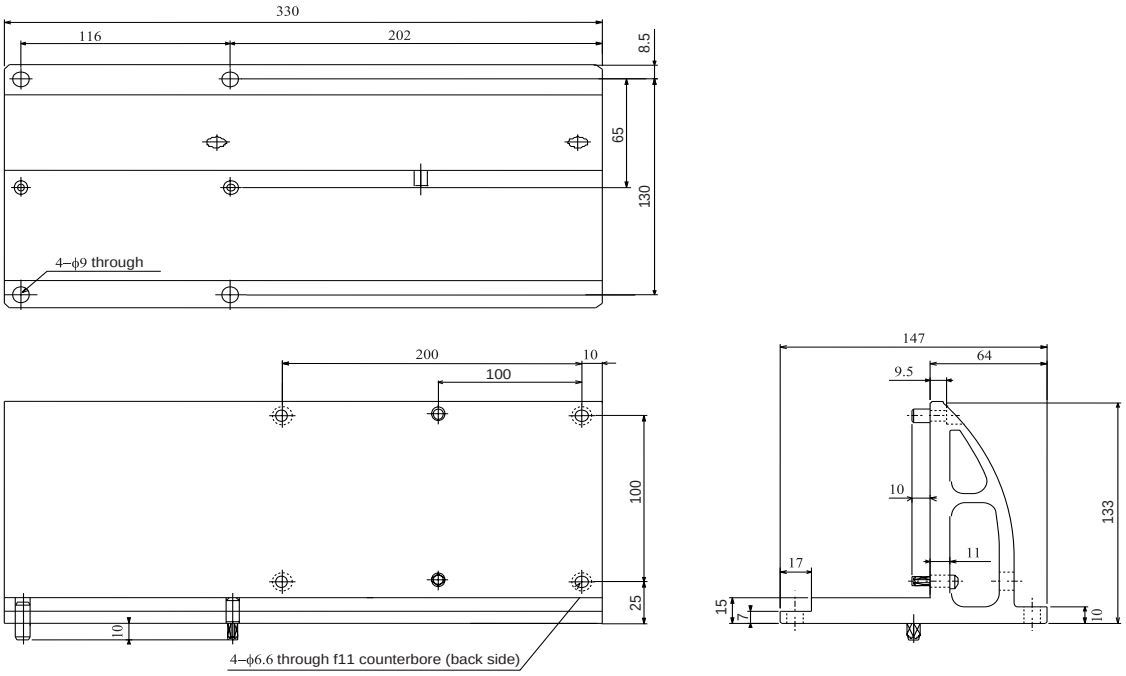


Figure 8-16. GHM Bracket

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GMS Bracket

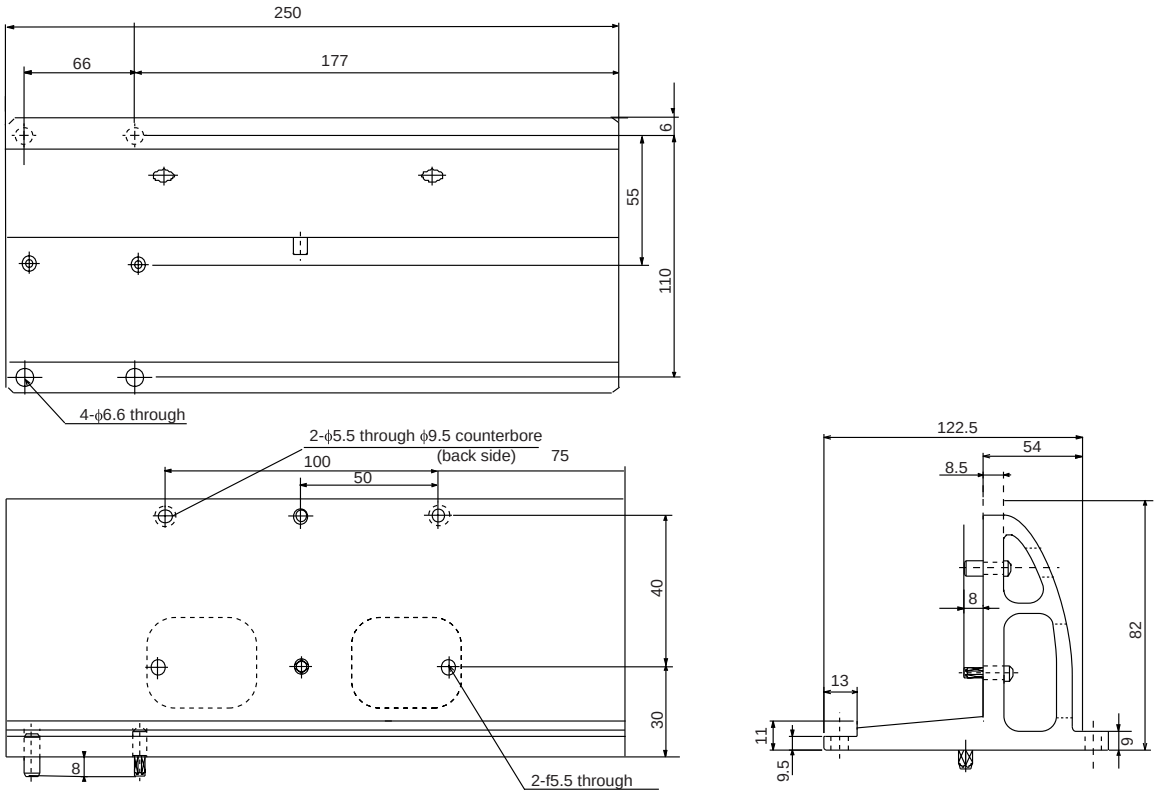


Figure 8-17. GMS Bracket

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GSS Bracket

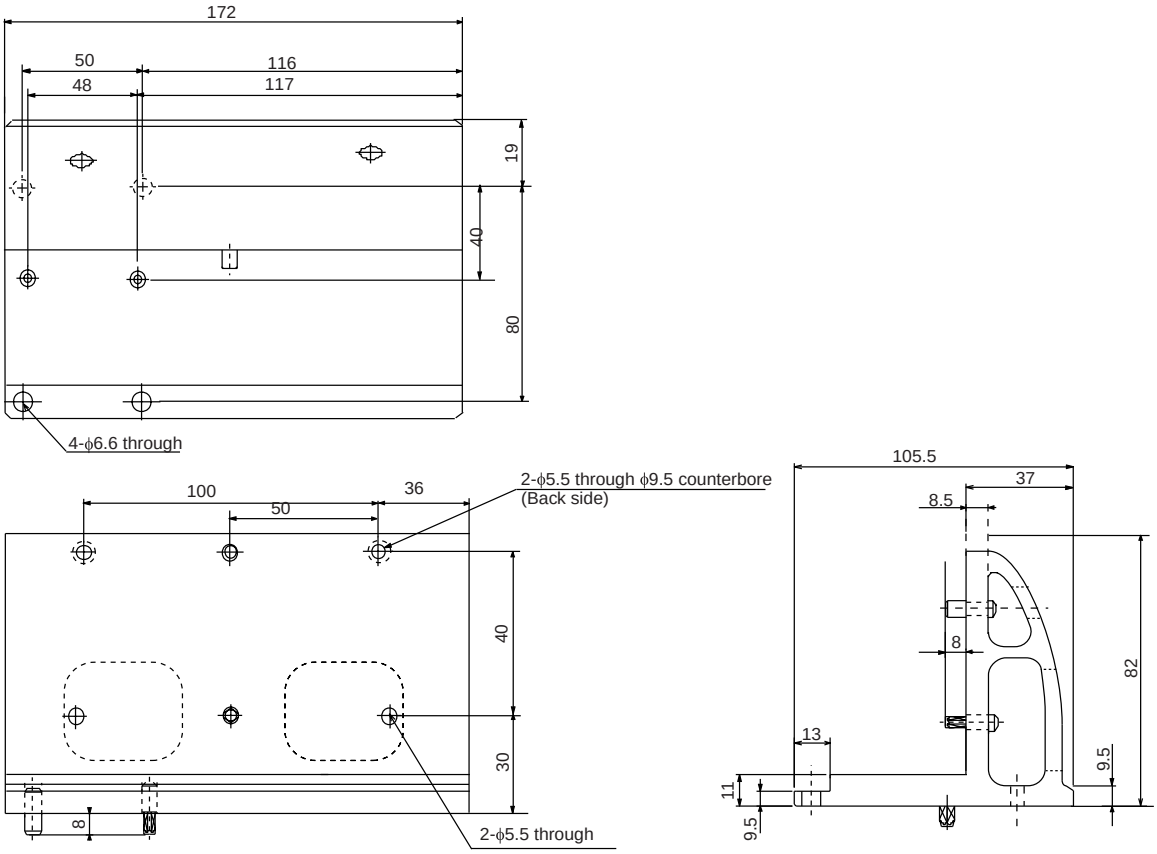


Figure 8-18. GSS Bracket

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XHH Bracket

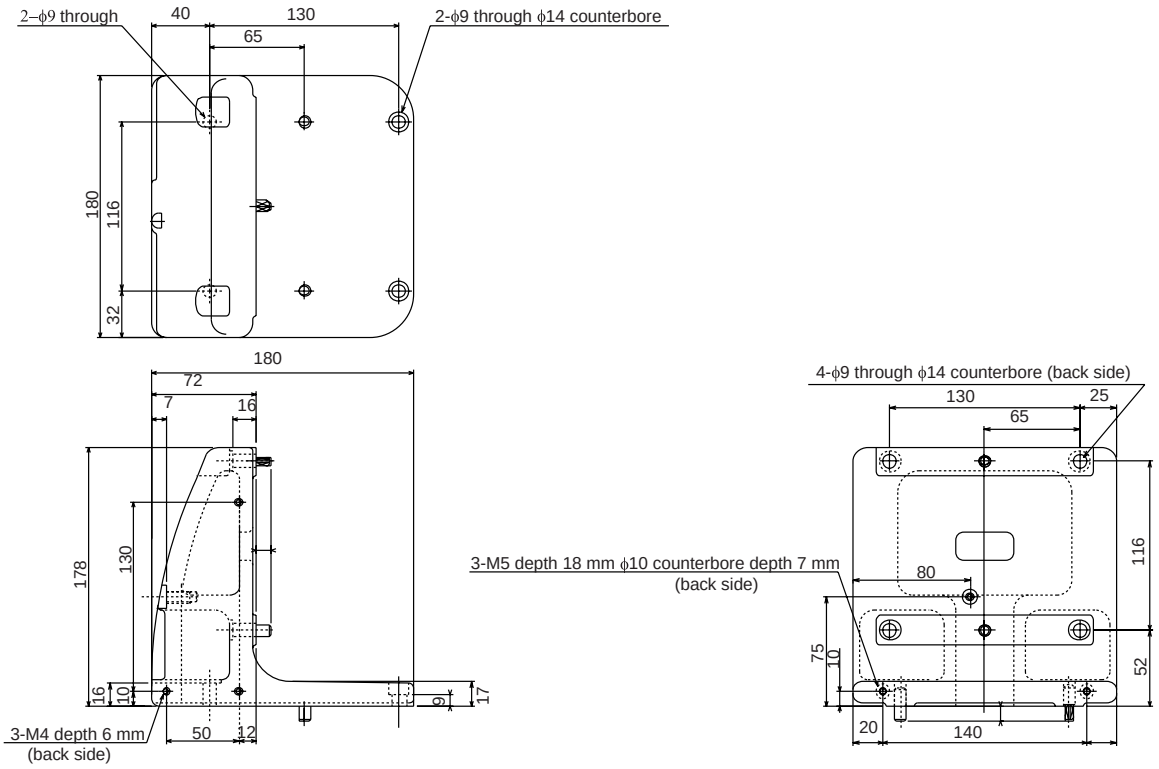


Figure 8-19. XHH Bracket

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XHM Bracket

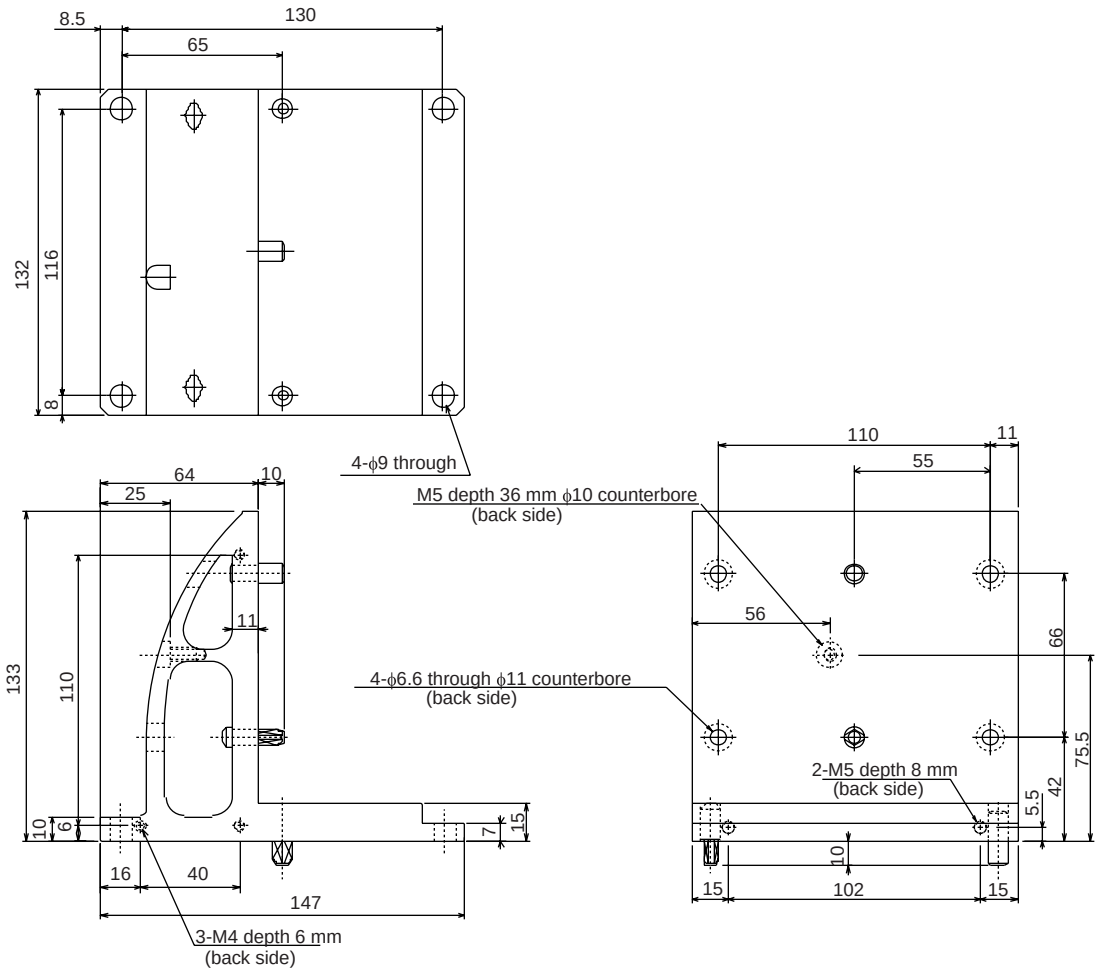


Figure 8-20. XHM Bracket

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XMM Bracket

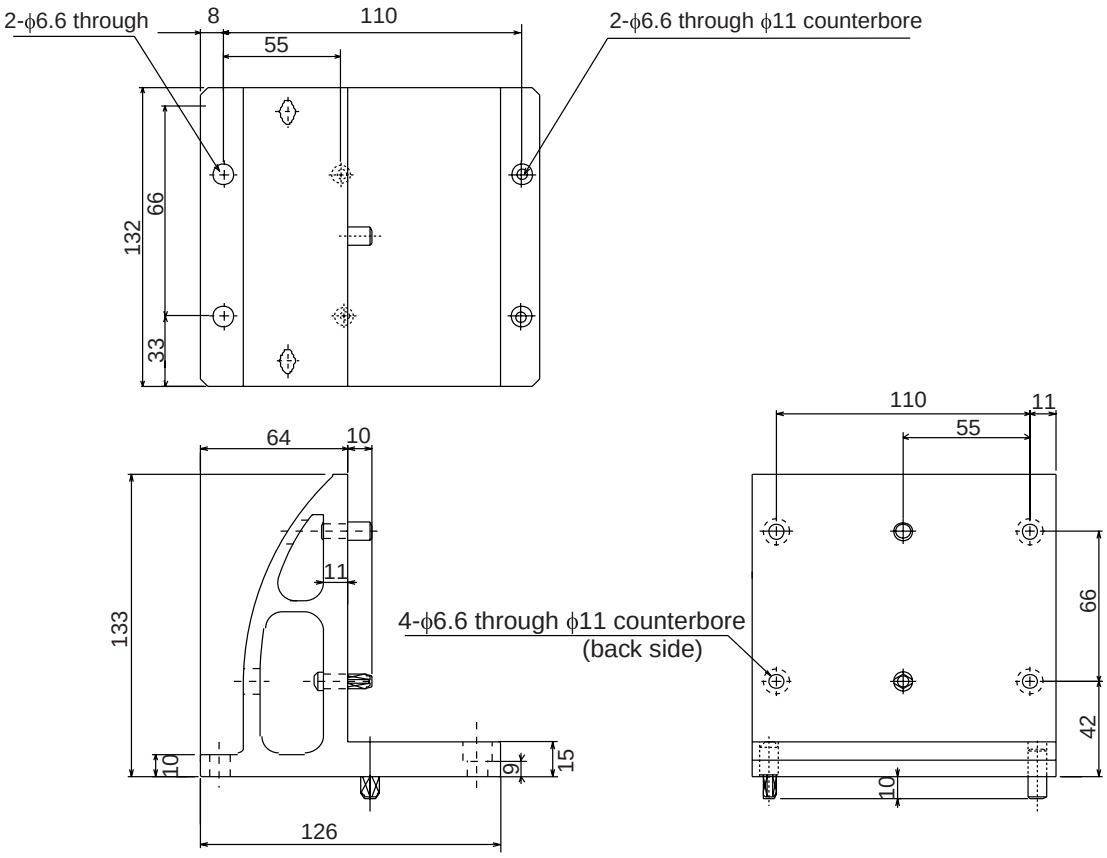


Figure 8-21. XMM Bracket

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TMS Bracket

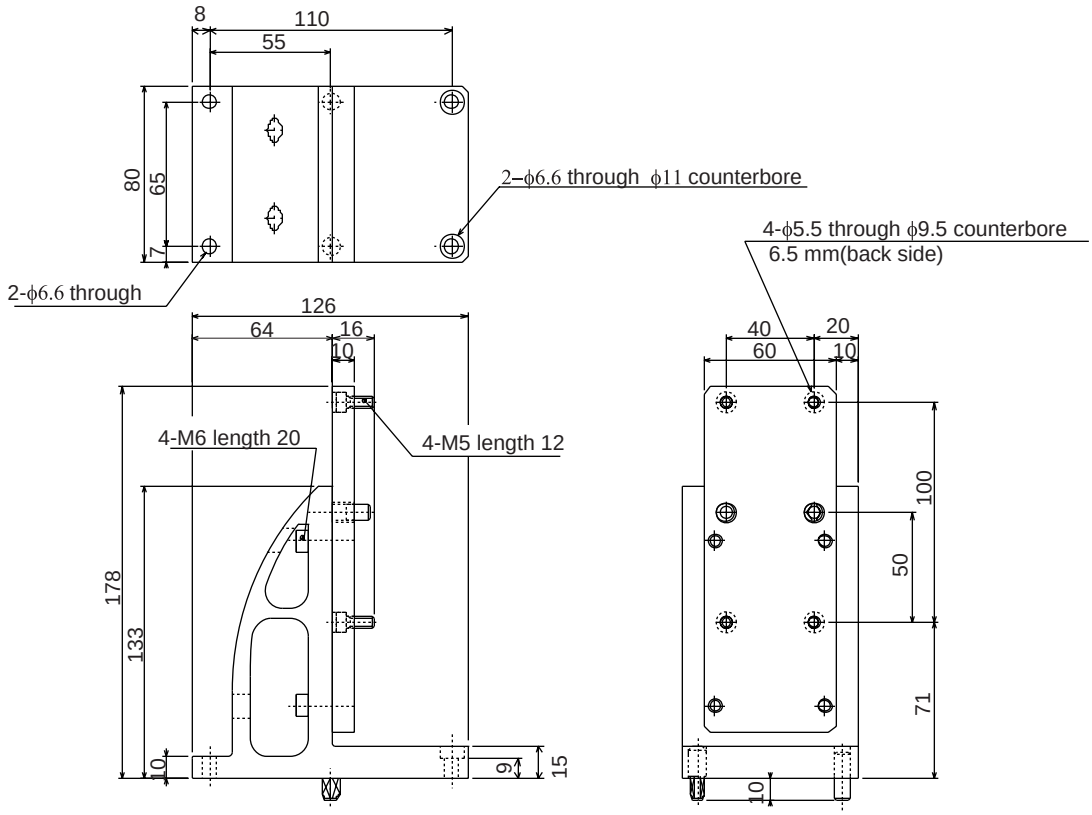
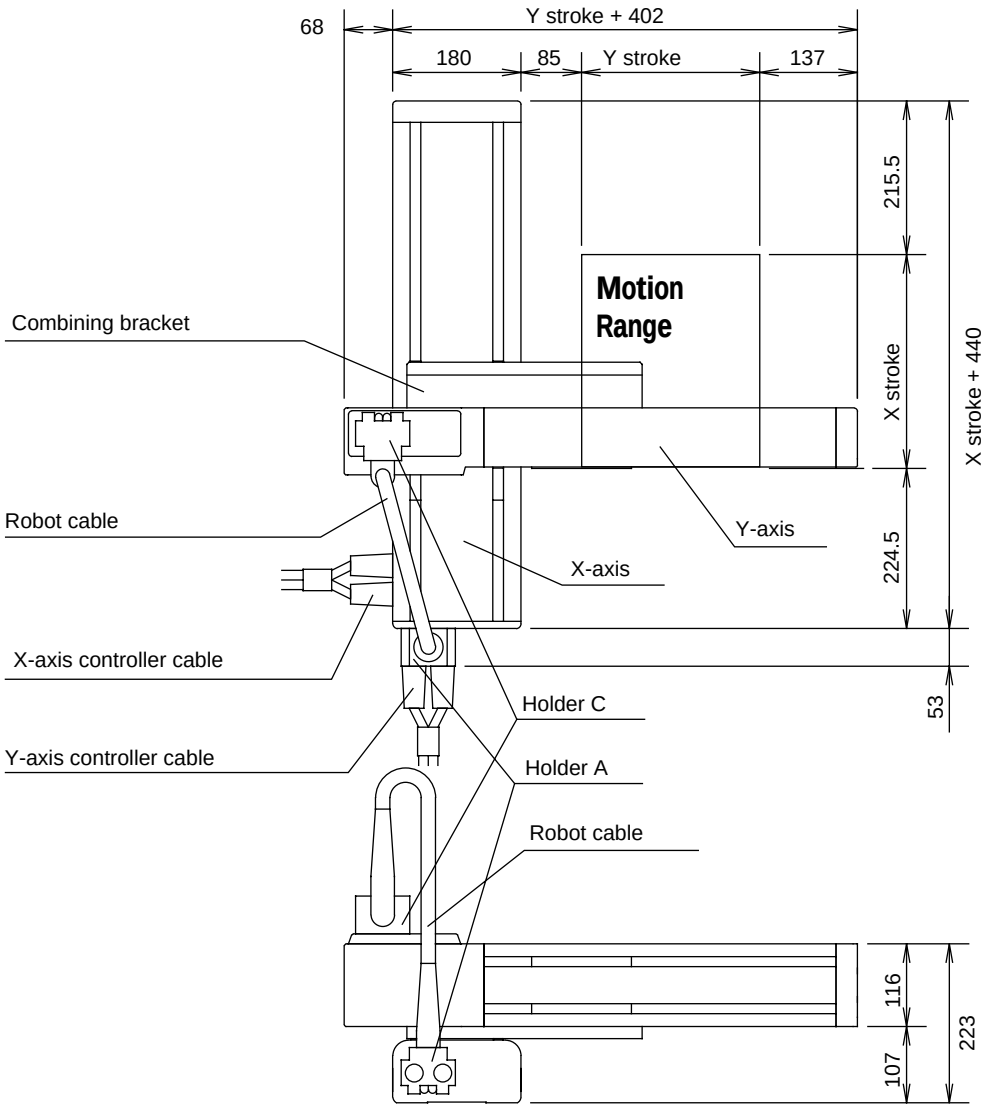


Figure 8-22. TMS Bracket

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8.4 Work Envelopes and Payload Capacities

G1 Configuration

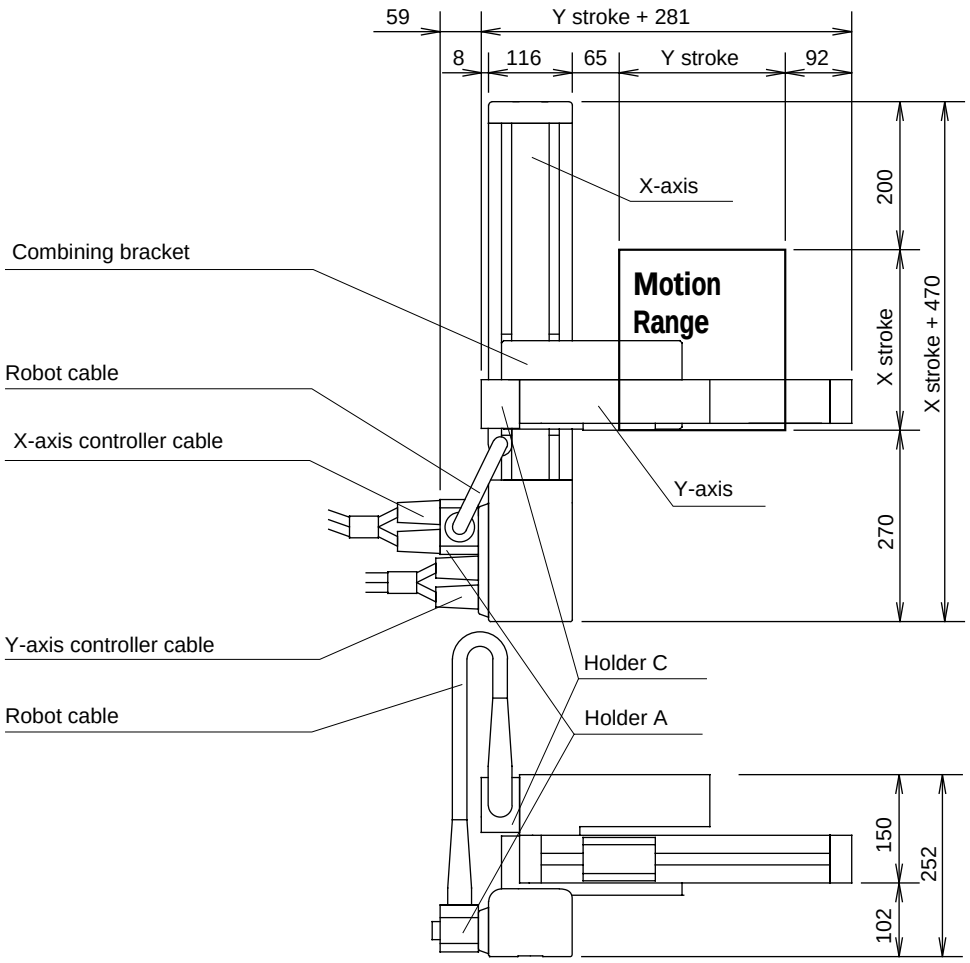


Y stroke	[mm]	250 to 550	750	950
Transportable load	[kg]	40	35	30

Figure 8-23. G1 Type Configuration

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G2 Configuration

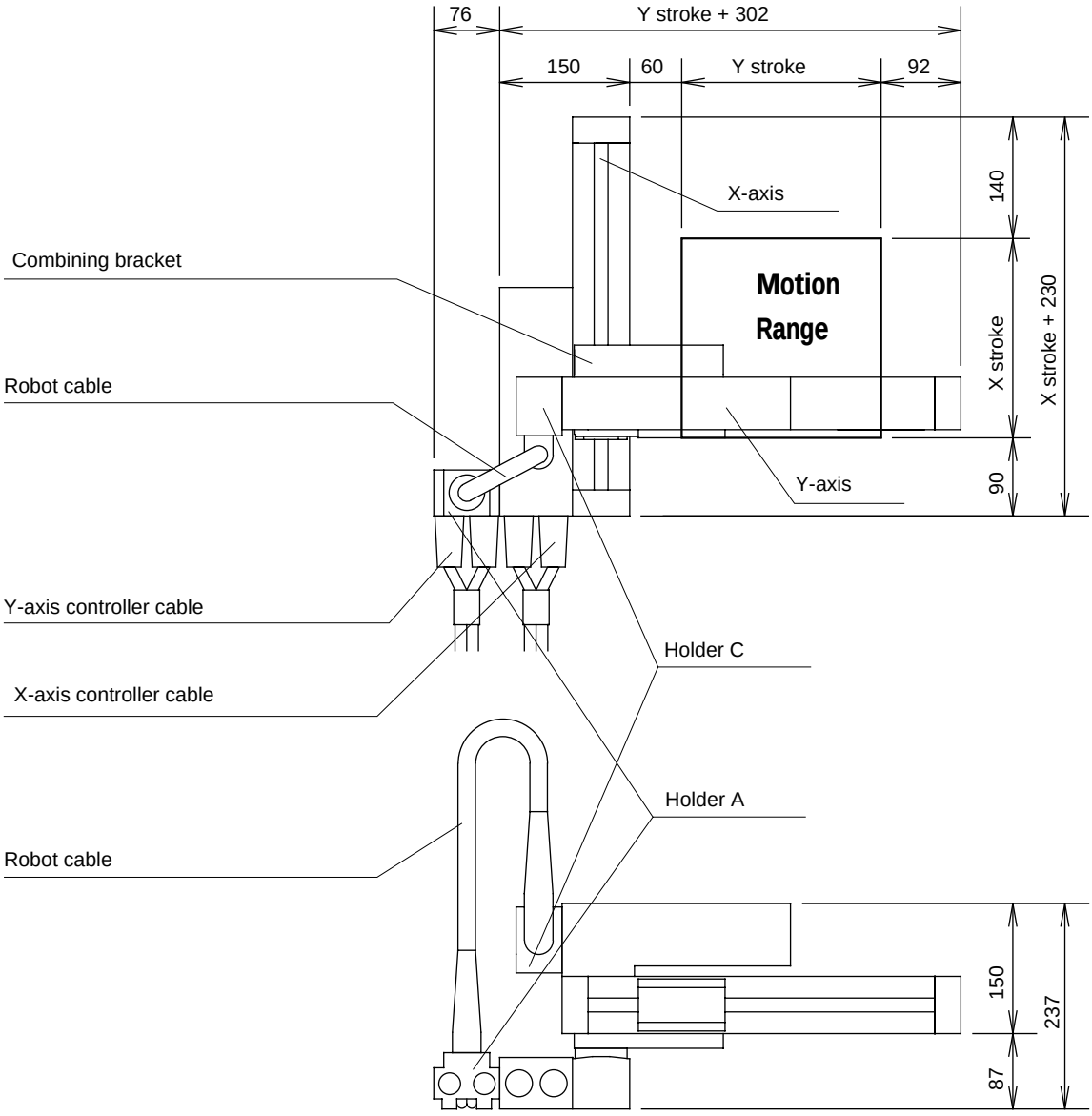


Y stroke	[mm]	130	230	330	430	530
Transportable load	[kg]	20	16	11	8	5

Figure 8-24. G2 Type Configuration

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G3 Configuration

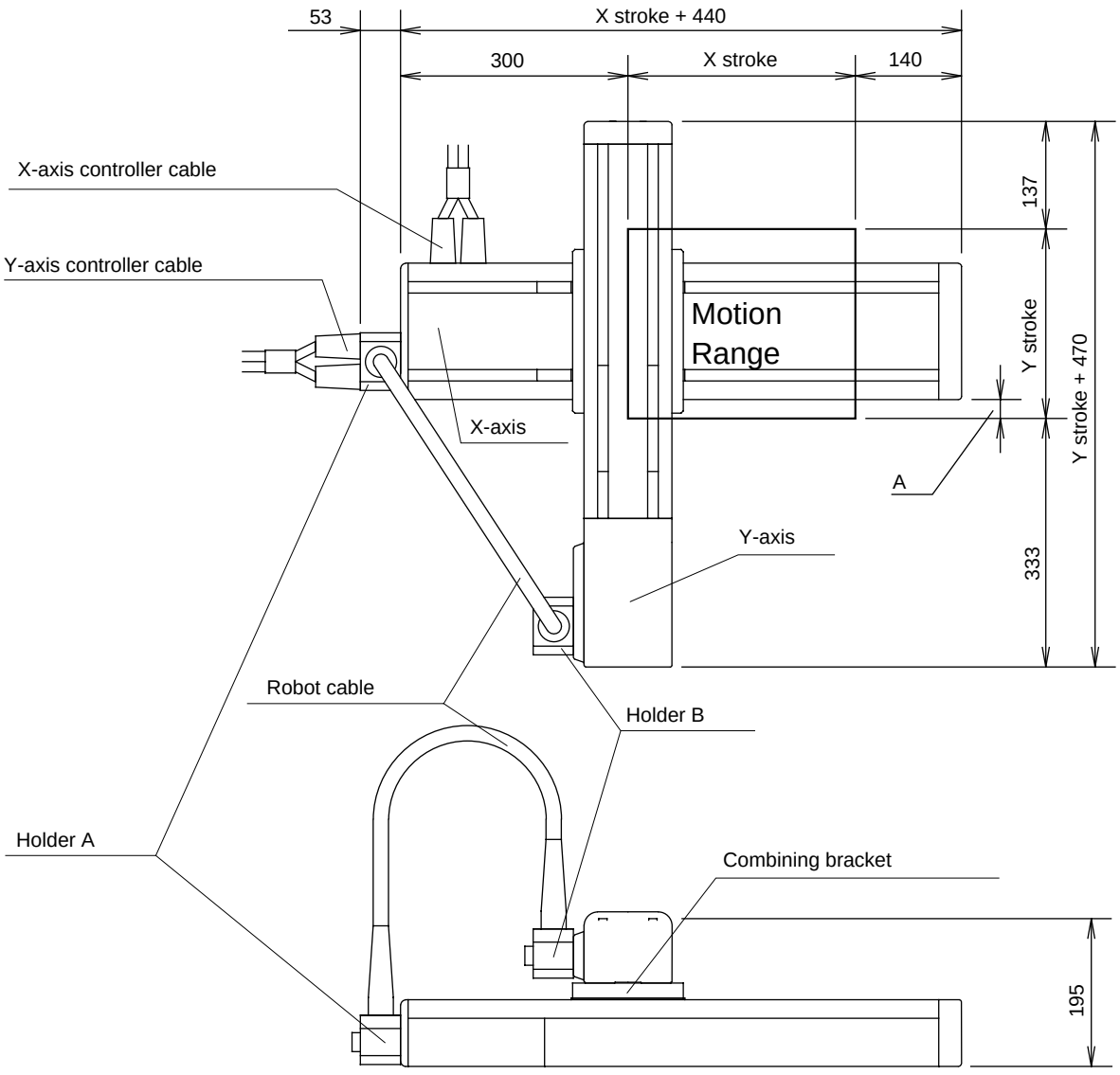


Y stroke	[mm]	130	230	330
Transportable load	[kg]	8	4	2

Figure 8-25. G3 Type Configuration

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D1 Configuration

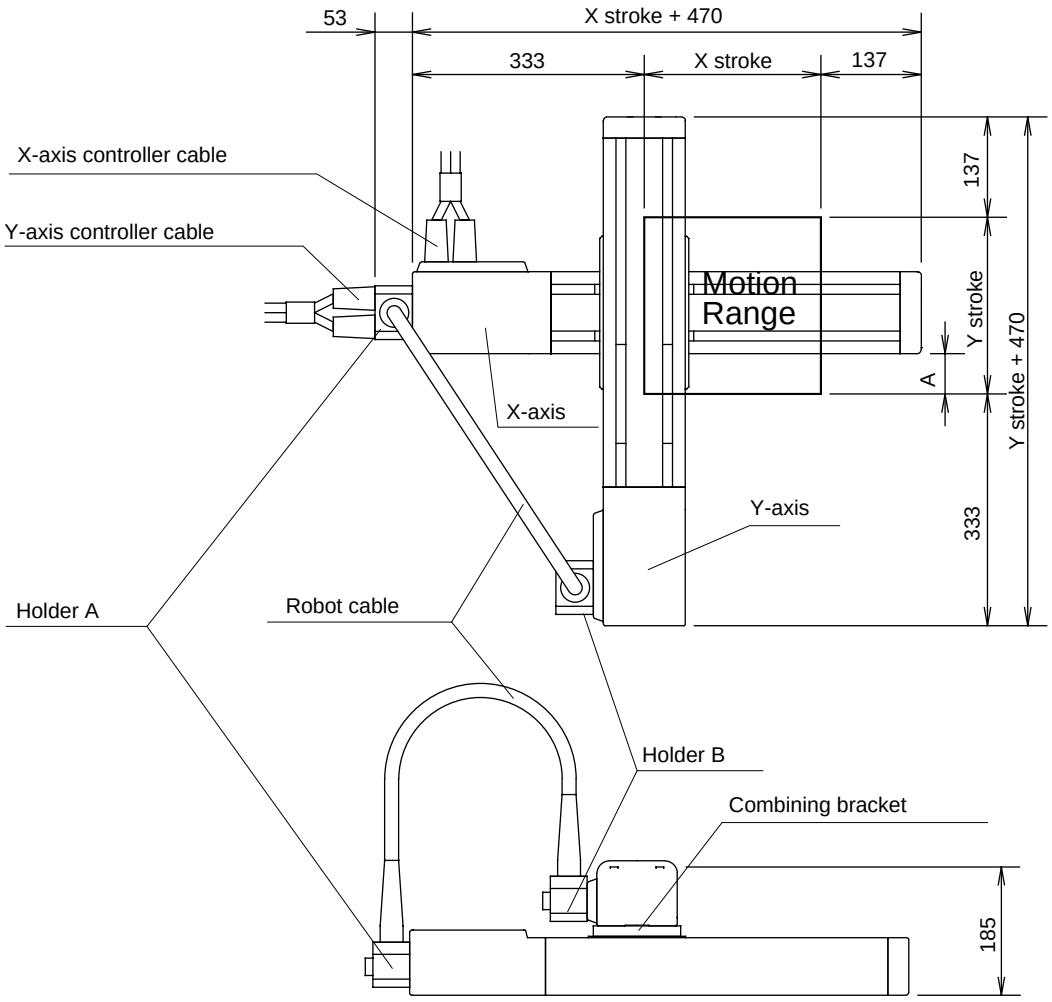


Y stroke	[mm]	250 to 750	950
Transportable load	[kg]	40	38

Figure 8-26. D1 Type Configuration

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D2 Configuration

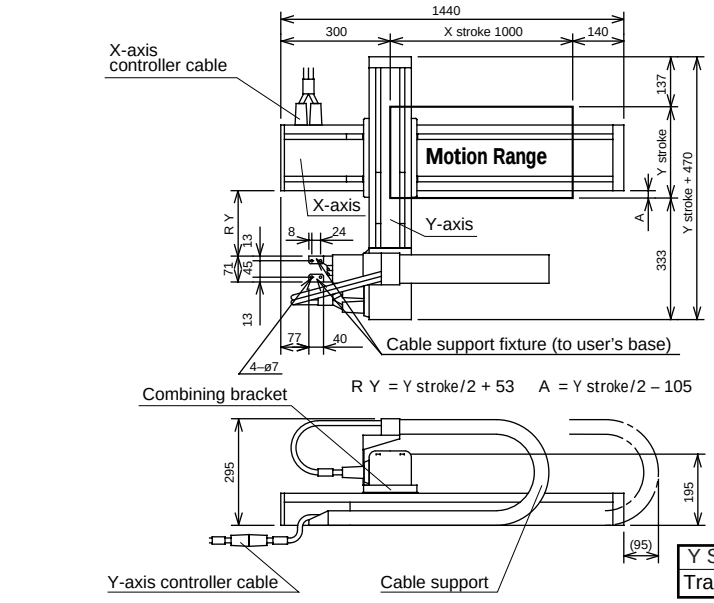


Y stroke [mm]	250	350	450	550	750	950
Transportable load[kg]	28	27	26	24	18	14

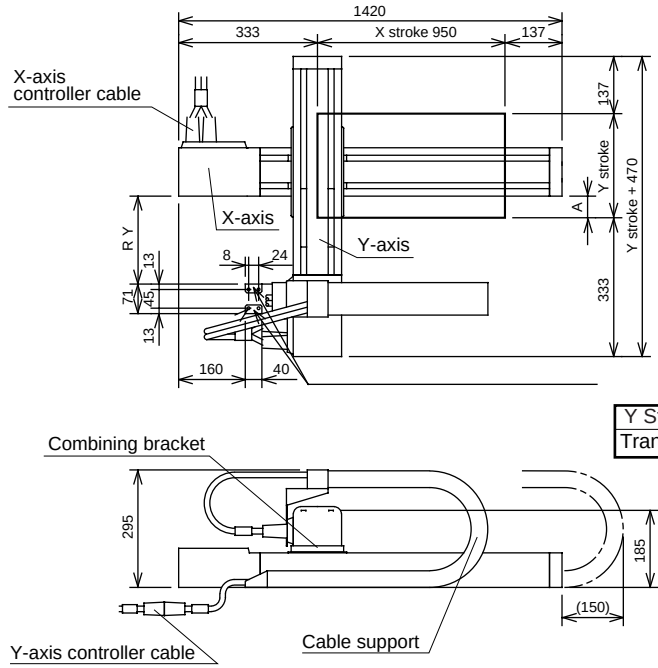
Figure 8-27. D2 Type Configuration

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D1 and D2 Extended Stroke Configurations



Y Stroke [mm]	250 to 750	950
Transportable load [kg]	40	38

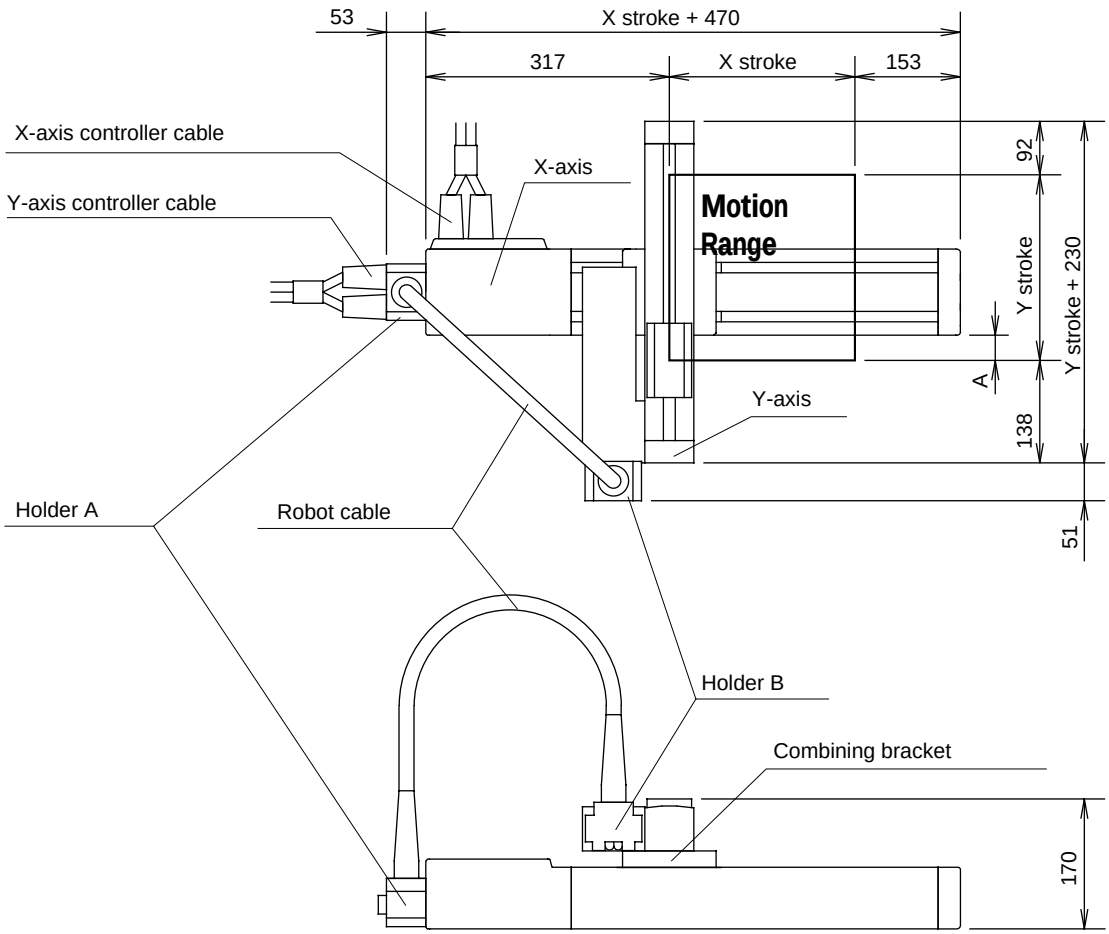


Y Stroke [mm]	250	350	450	550	750	950
Transportable load [kg]	28	27	26	24	18	14

Figure 8-28. D1 and D2 Extended Stroke Configurations

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D3 Configuration

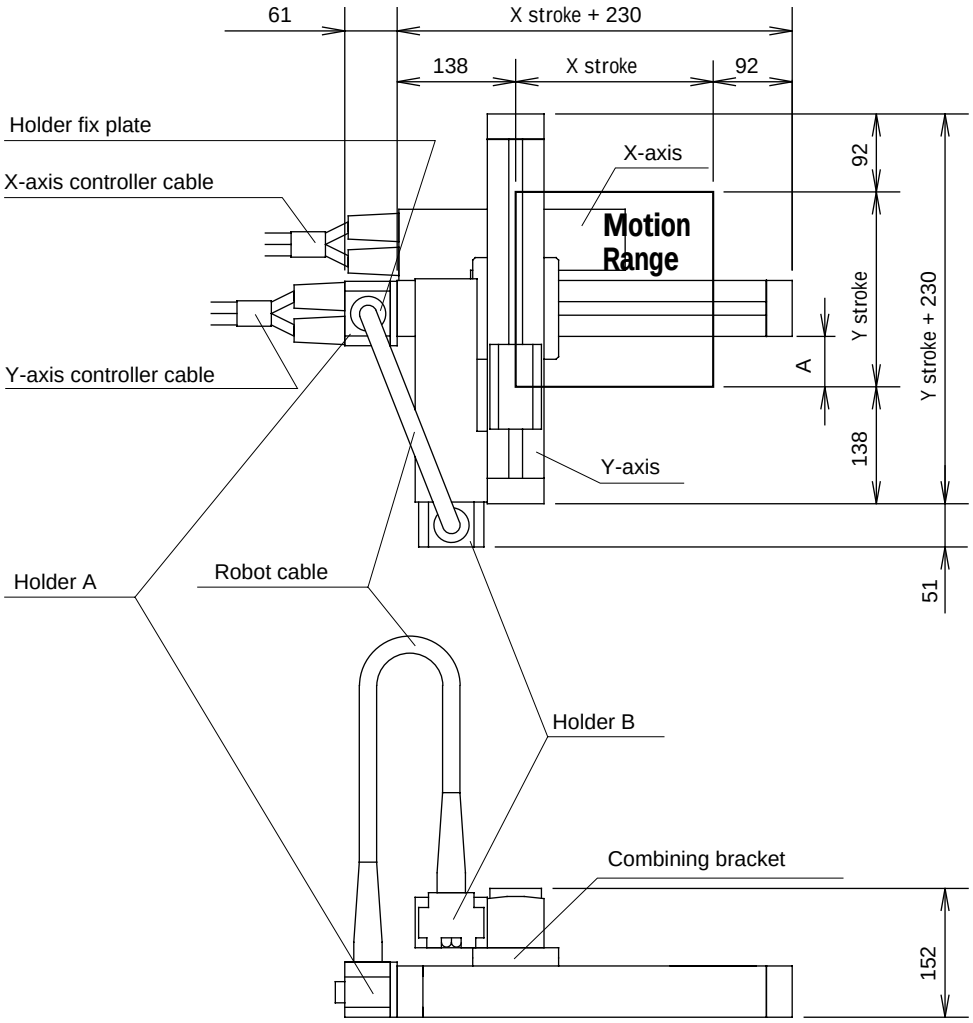


Transportable load: 20kg

Figure 8-29. D3 Type Configuration

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D4 Configuration

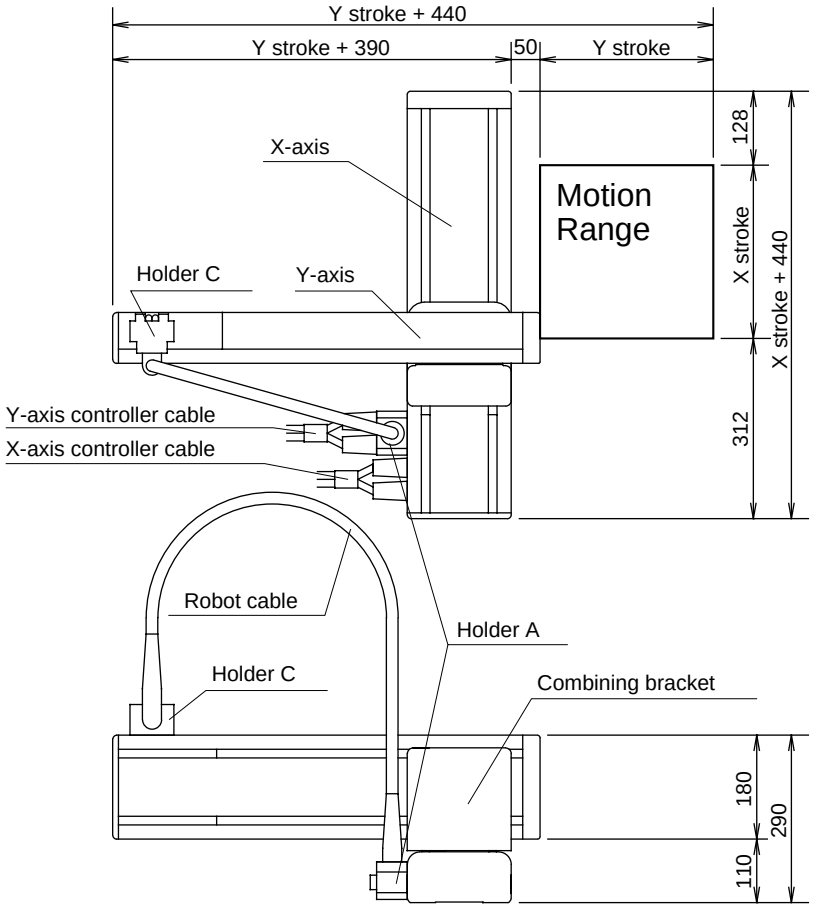


Y stroke [mm]	130	230	330	430	530
Transportable load [kg]	14	13	12	11	10

Figure 8-30. D4 Type Configuration

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X1 Configuration

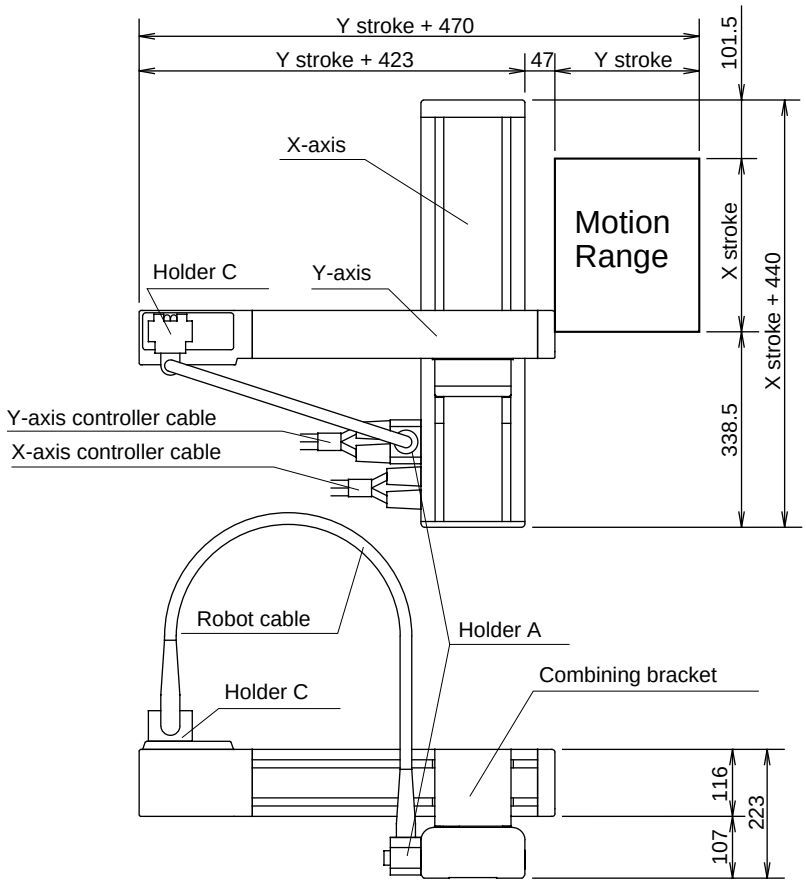


Y Stroke [mm]	300	400	500	600	800	1000
Transportable load[kg]	37	35	33	31	27	20

Figure 8-31. X1 Type Configuration

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X2 Configuration

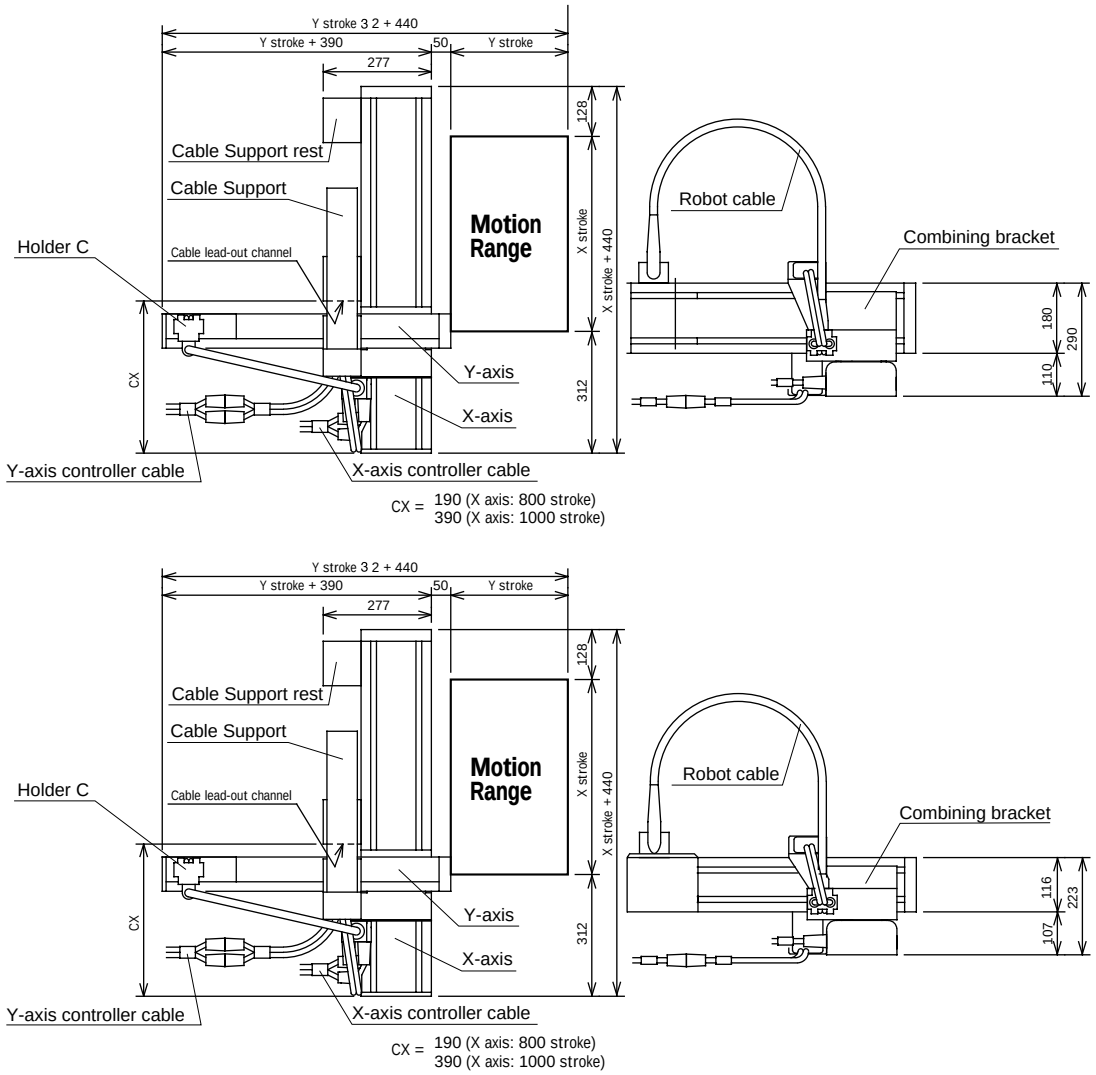


Y Stroke [mm]	250	350	450	550	750	950
Transportable load[kg]	23	17	13	10	5	3

Figure 8-32. X2 Type Configuration

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X1 and X2 Extended Stroke Configuration

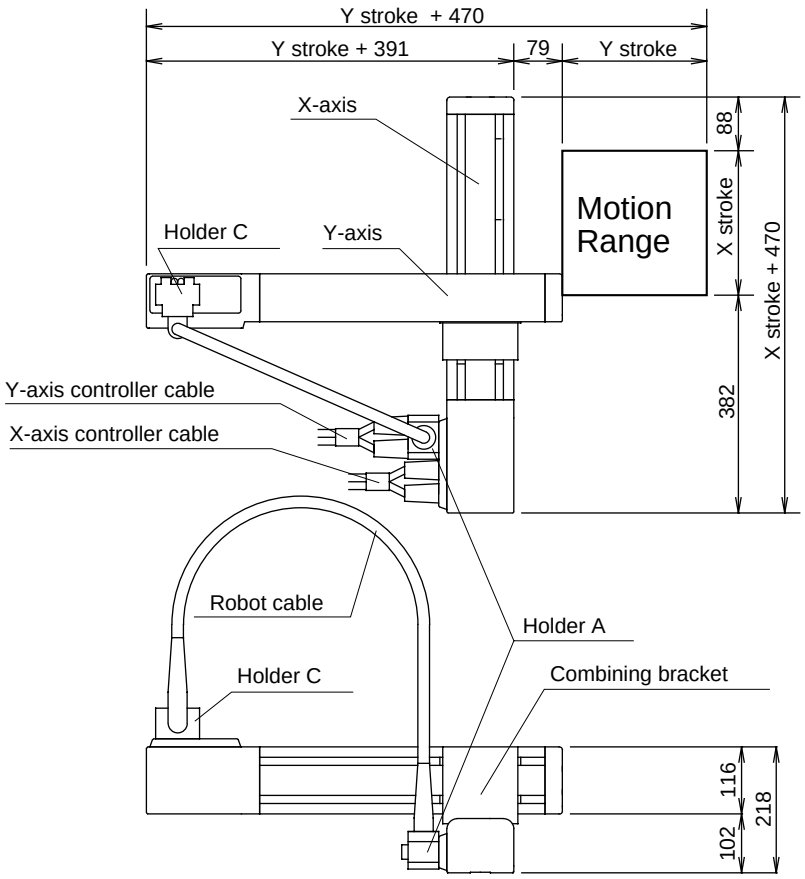


Y Stroke [mm]	250	350	450	550	750	950
Transportable load [kg]	23	17	13	10	5	3

Figure 8-33. X1 and X2 Extended Stroke Configurations

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X3 Configuration

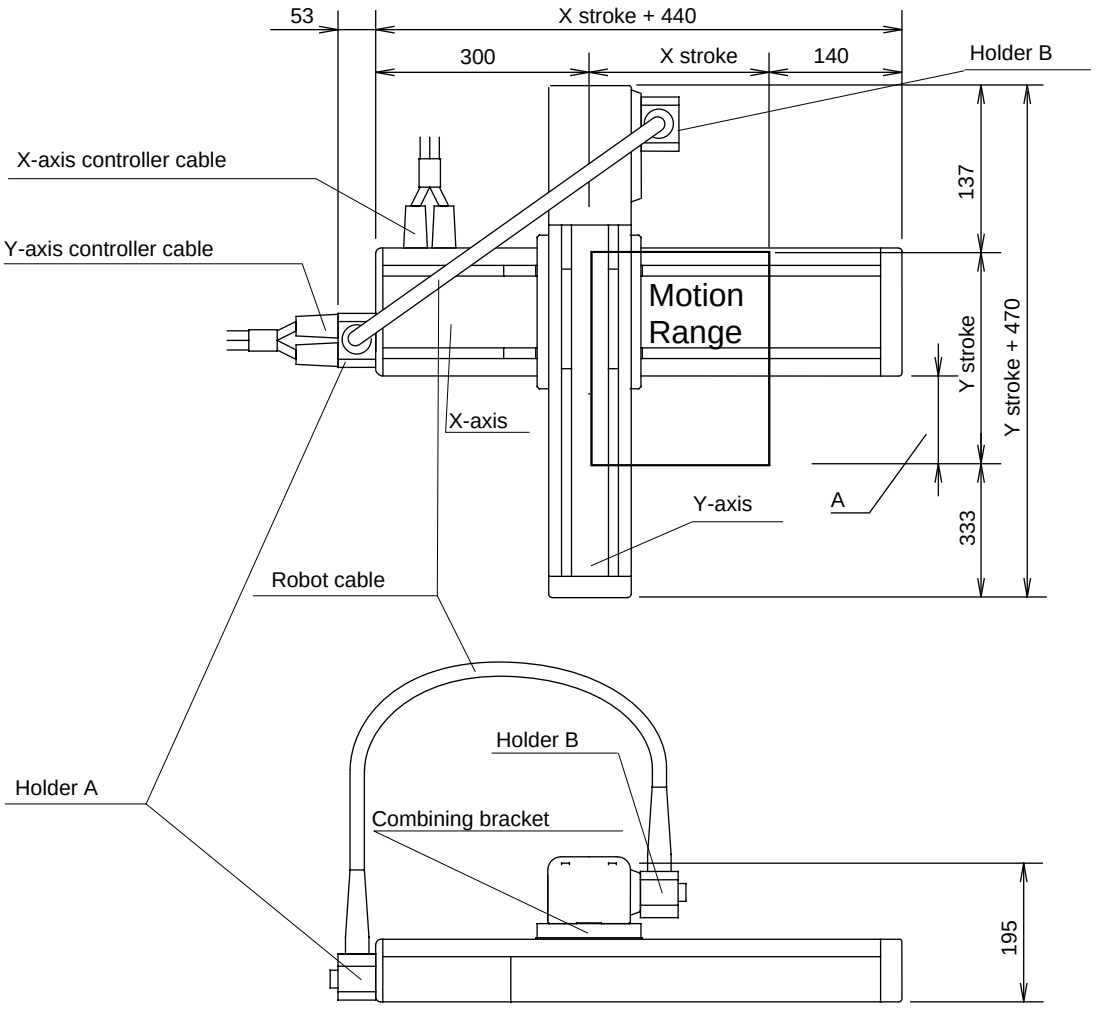


Y stroke [mm]	250	350	450	550
Transportable load [kg]	11	8	6	3

Figure 8-34. X3 Type Configuration

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K2 Configuration

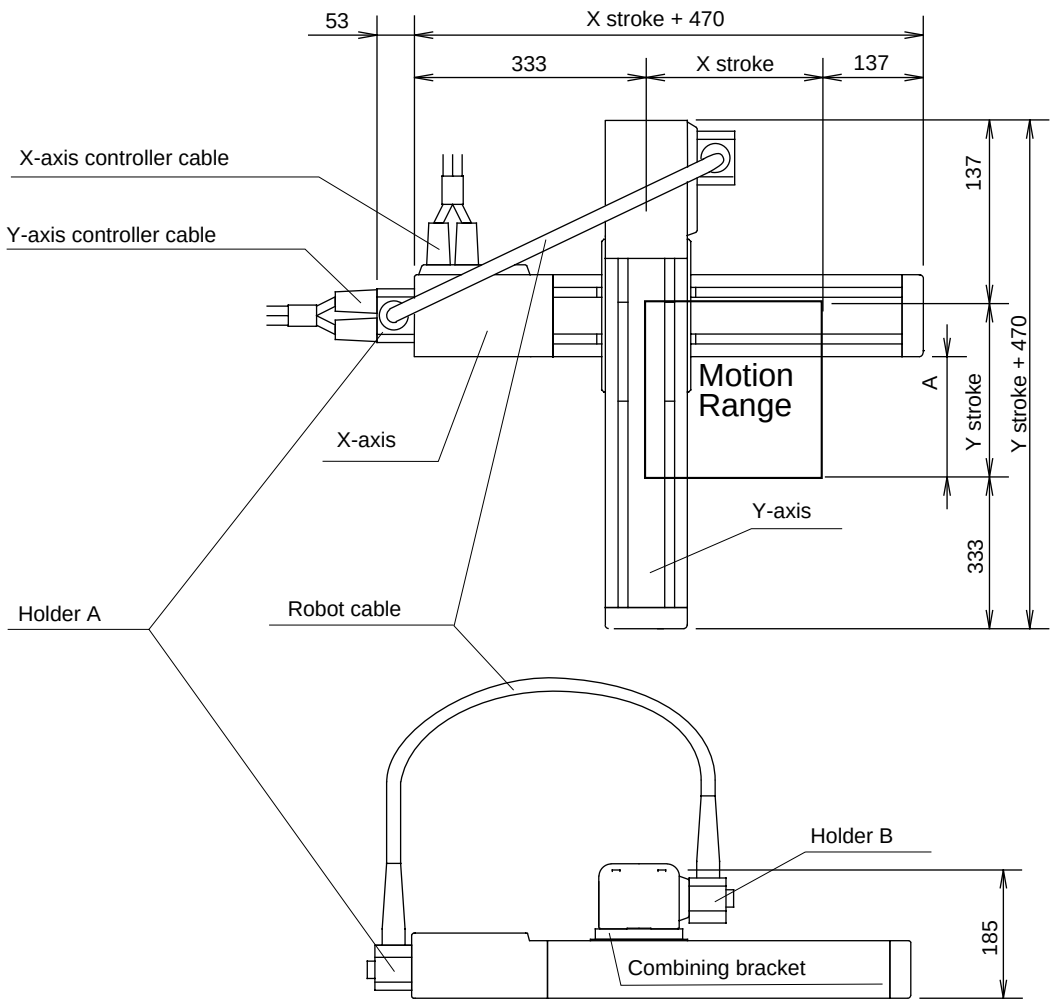


Z stroke	[mm]	250 TO 950
Transportable load	[kg]	40

Figure 8-35. K2 Type Configuration

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K3 Configuration

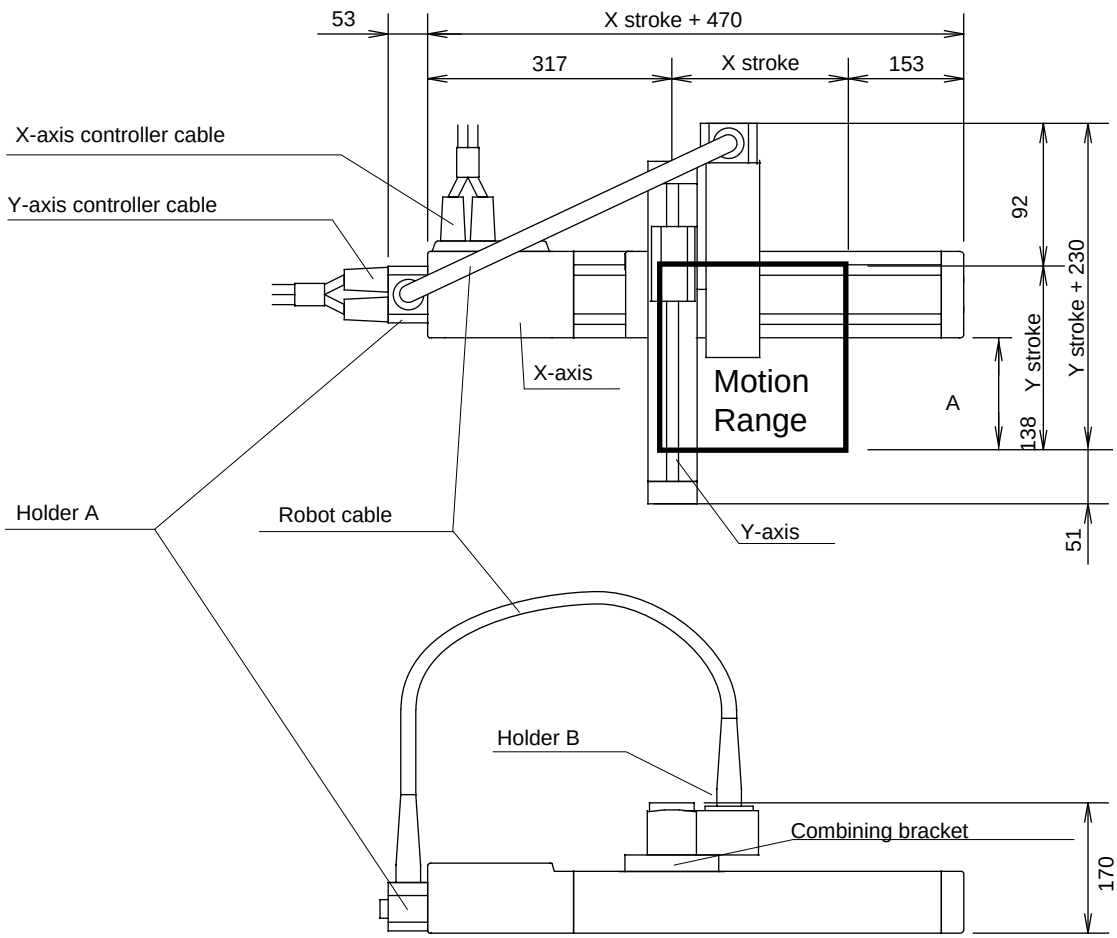


Y stroke [mm]	250	350	450	550	750	950
Transportable load[kg]	27.5	26.5	25.5	24.5	22	20

Figure 8-36. K3 Type Configuration

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K4 Configuration

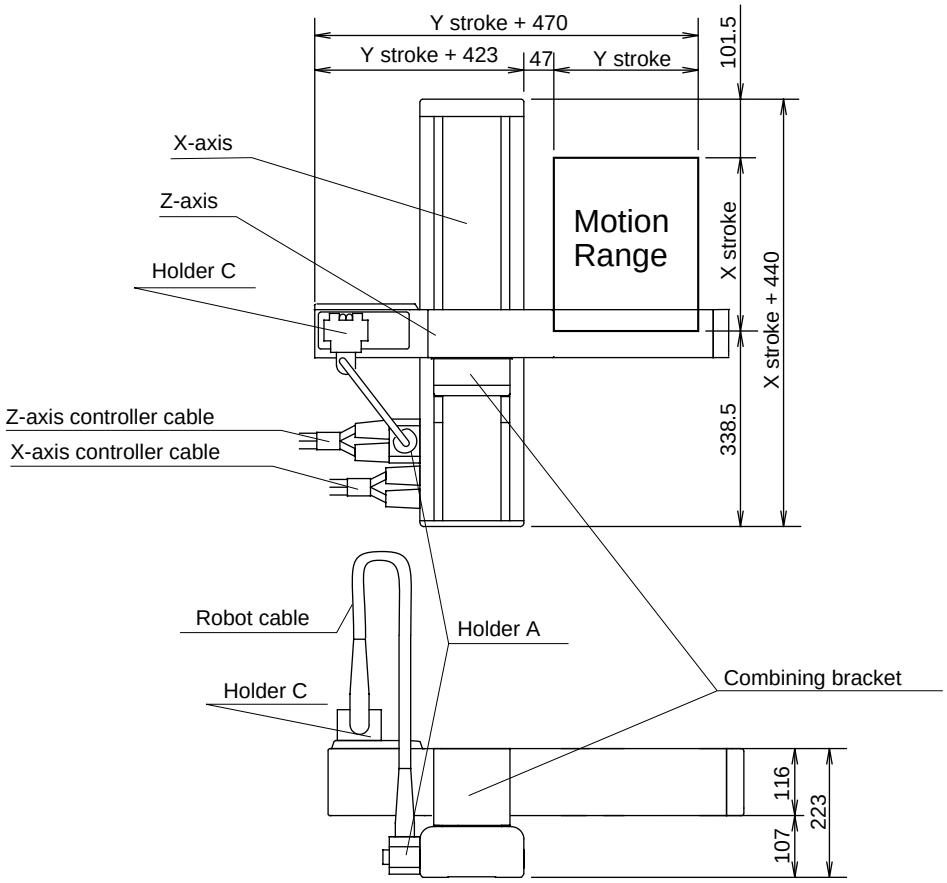


Y stroke	[mm]	130 TO 630
Transportable load	[kg]	15

Figure 8-37. K4 Type Configuration

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Z2 Configuration

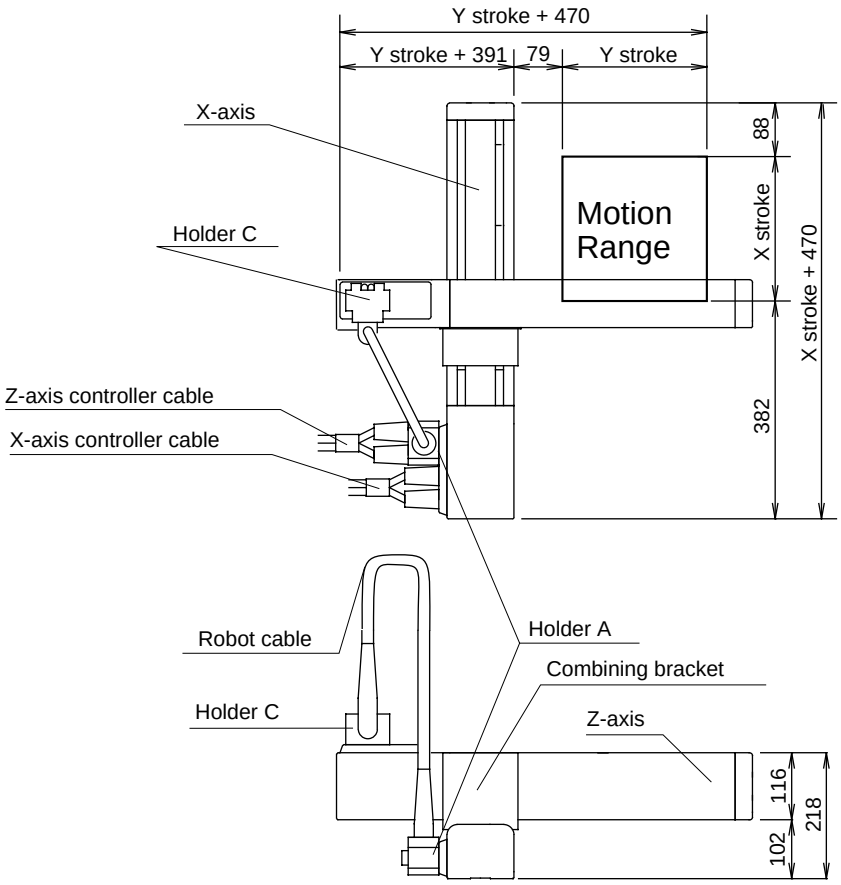


Z Stroke [mm]	250	350	450	550	750	950
Transportable load[kg]	27.5	26.5	25.5	24.5	22	20

Figure 8-38. Z2 Type Configuration

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Z3 Configuration

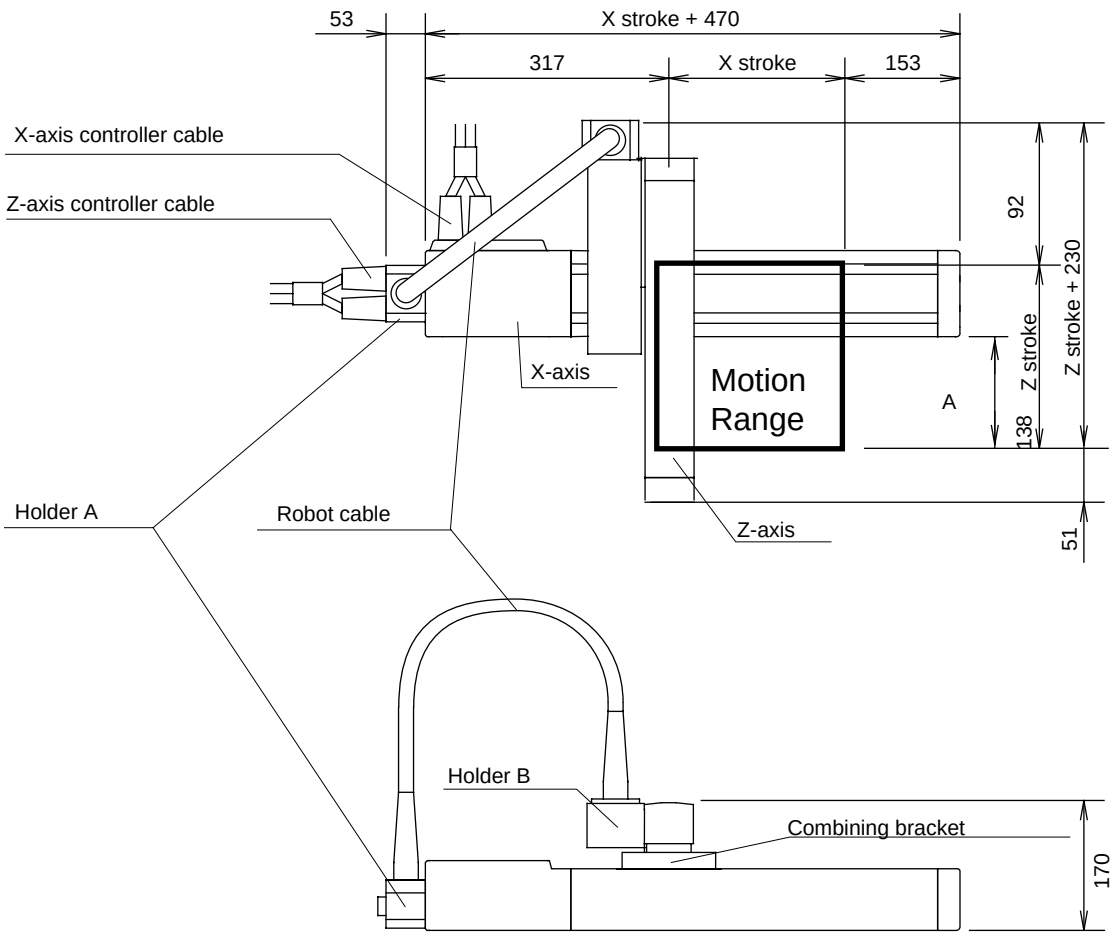


Z stroke [mm]	250	350	450	550	750	950
Transportable load [kg]	27.5	26.5	25.5	24.5	22	20

Figure 8-39. Z3 Type Configuration

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Z4 Configuration

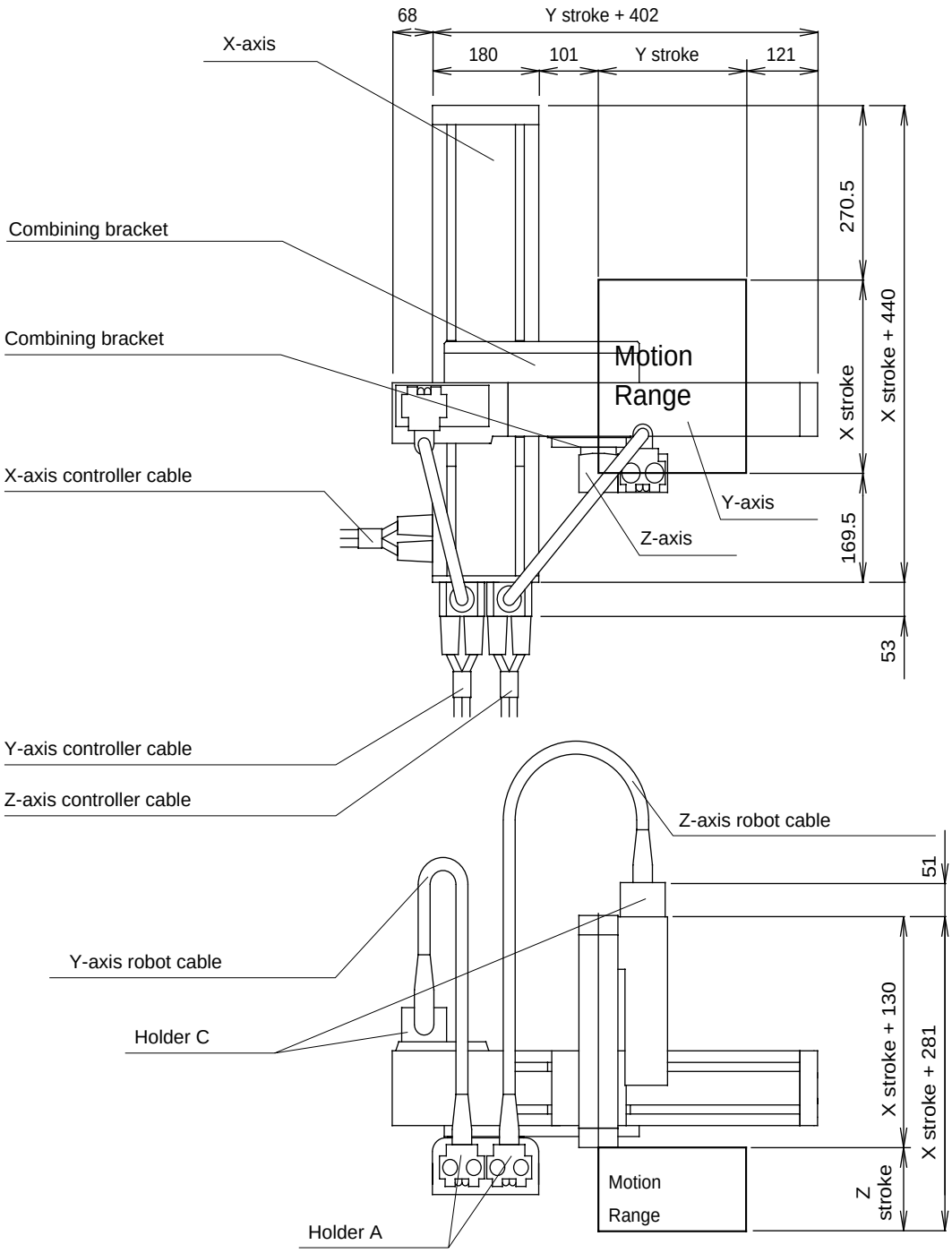


Z stroke [mm]	130	230	330	330	430	530	530
Transportable load [kg]	9.5	8.8	8.2	8.2	7.5	6.8	6.8

Figure 8-40. Z4 Type Configuration

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P1 Unit Stroke Configuration

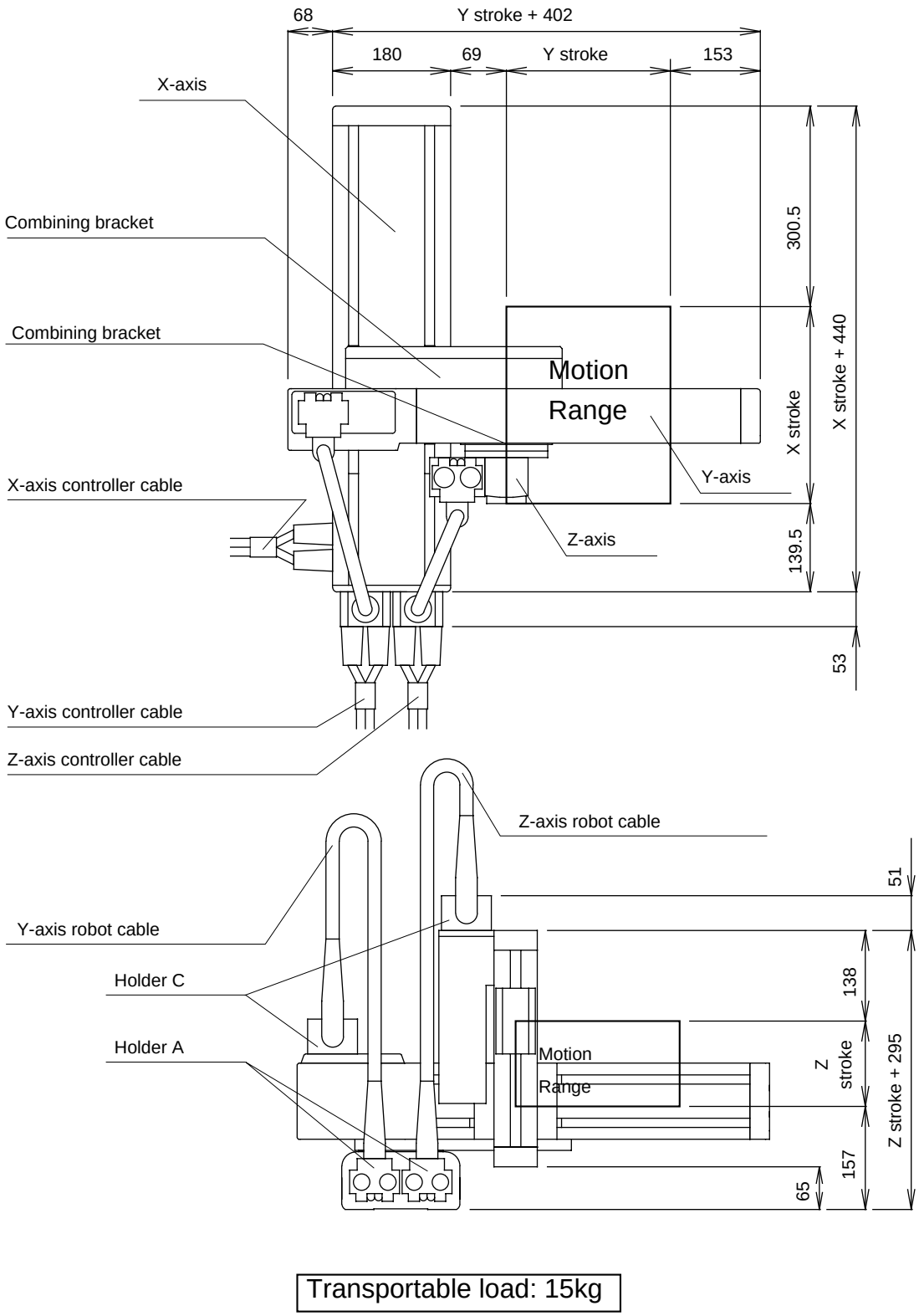


Y stroke	[mm]	130	230
Transportable load	[kg]	10	9

Figure 8-41. P1 Unit Stroke Configuration

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P1 Slider Stroke Configuration



Transportable load: 15kg

Figure 8-42. P1 Slider Stroke Configuration

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P1 Extended Stroke Configuration

Transportable load	15 [kg]

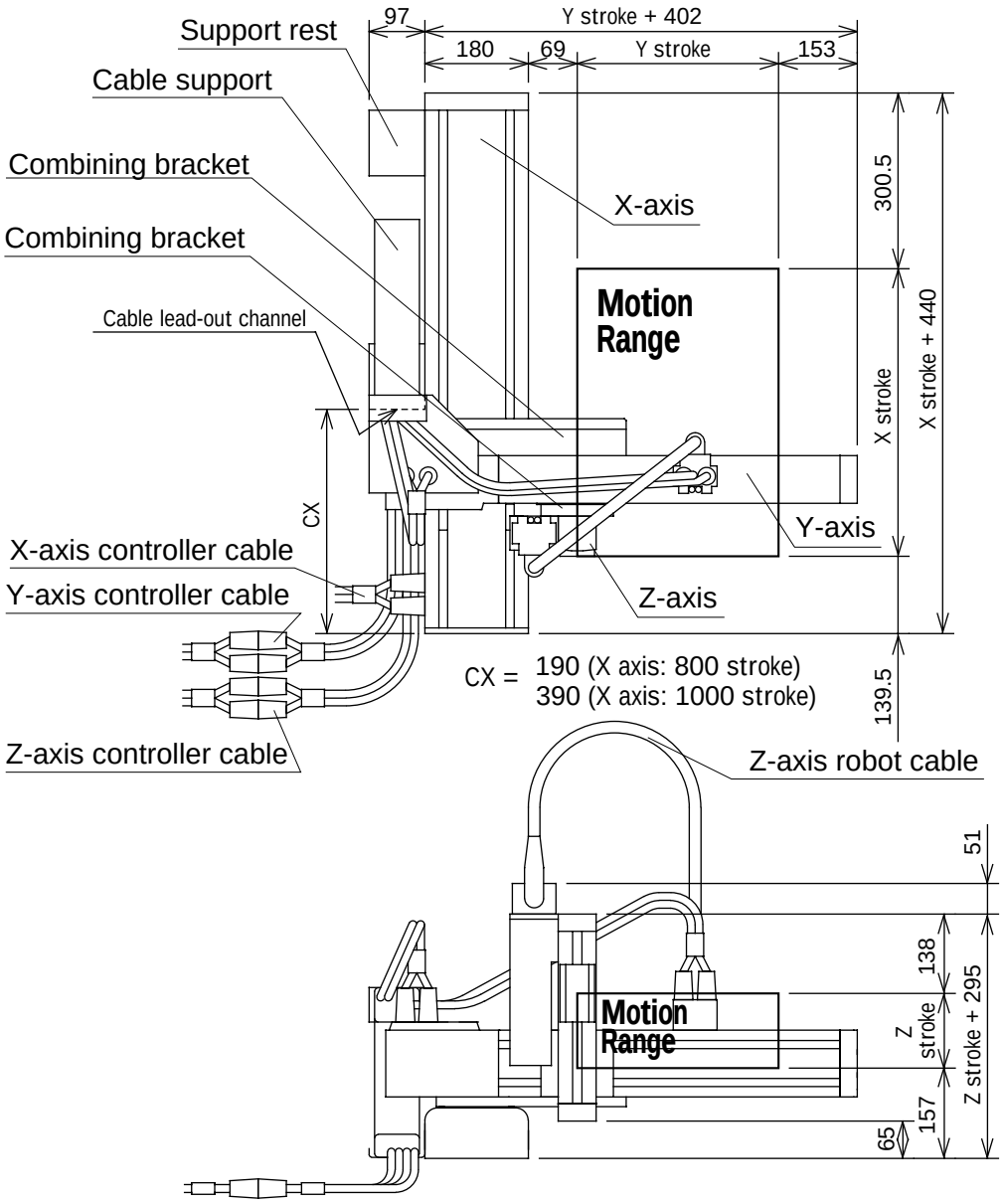
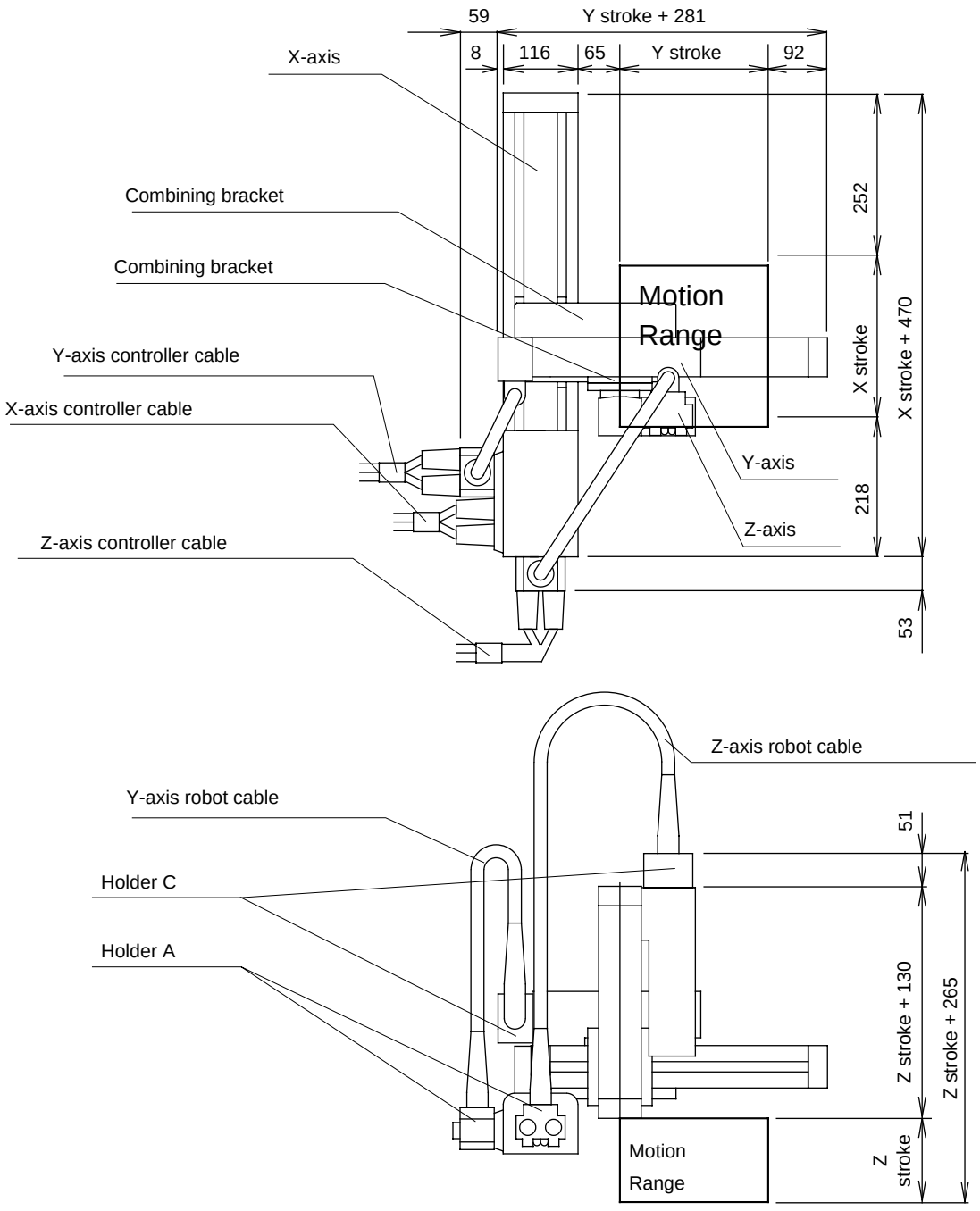


Figure 8-43. P1 Extended Stroke Configuration

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P2 Unit Stroke Configuration

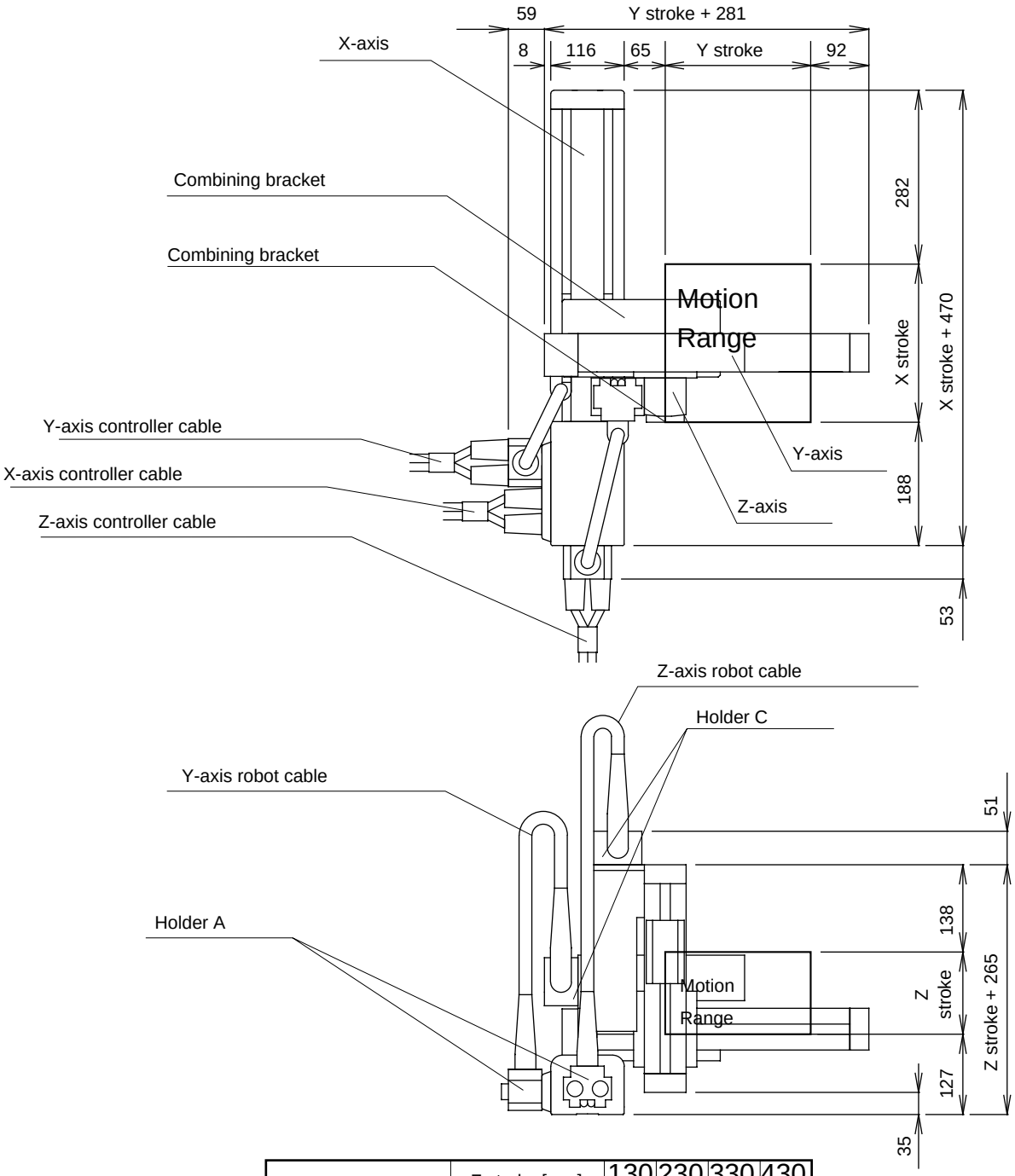


	Z stroke [mm]	130	230	330	430
Transportable load [kg]	130	10	10	5	2
	230	9	9	4	—

Figure 8-44. P2 Unit Stroke Configuration

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P2 Configuration

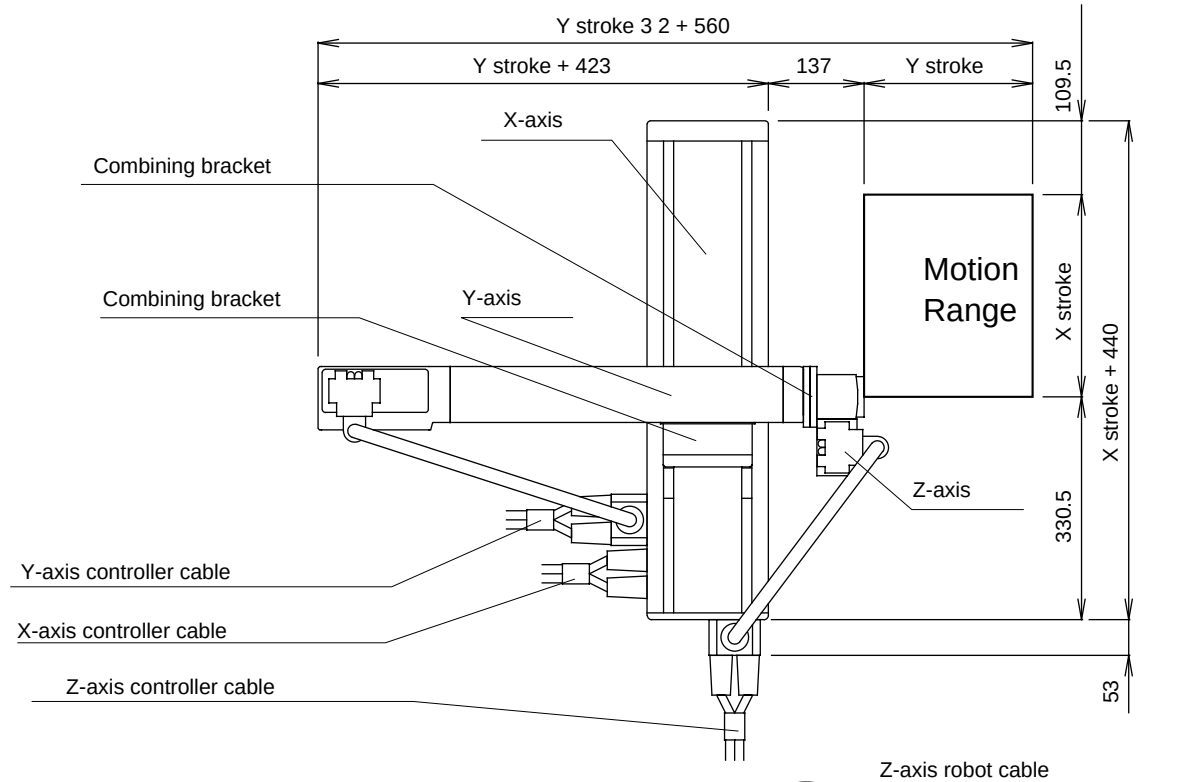


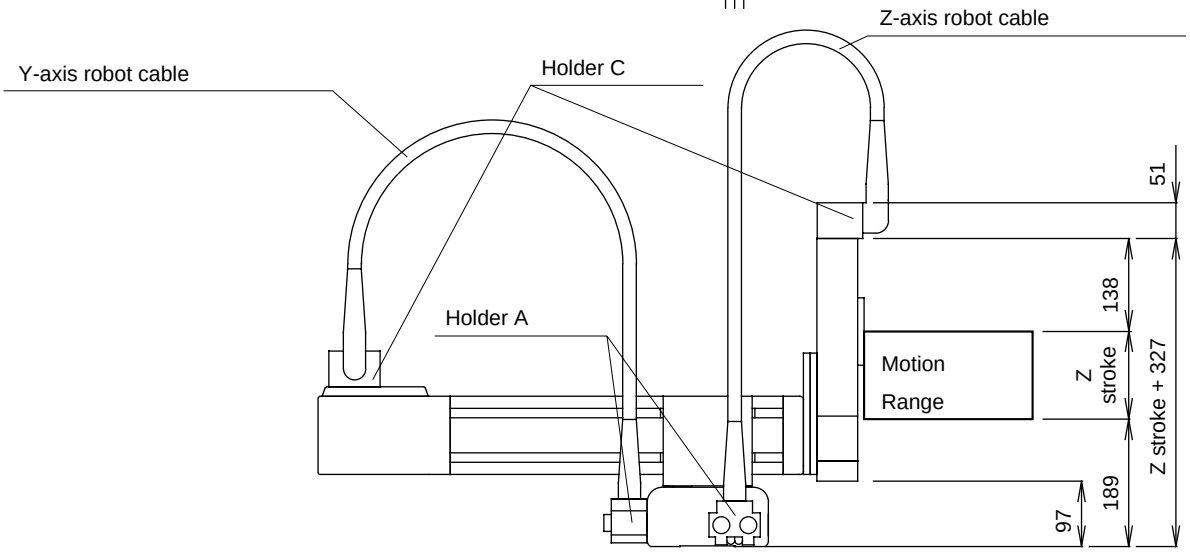
	Z stroke [mm]	130	230	330	430
Transportable load [kg]	130	14	10	5	2
	230	13	9	4	—

Figure 8-45. P2 Slider Stroke Configuration

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J Configuration



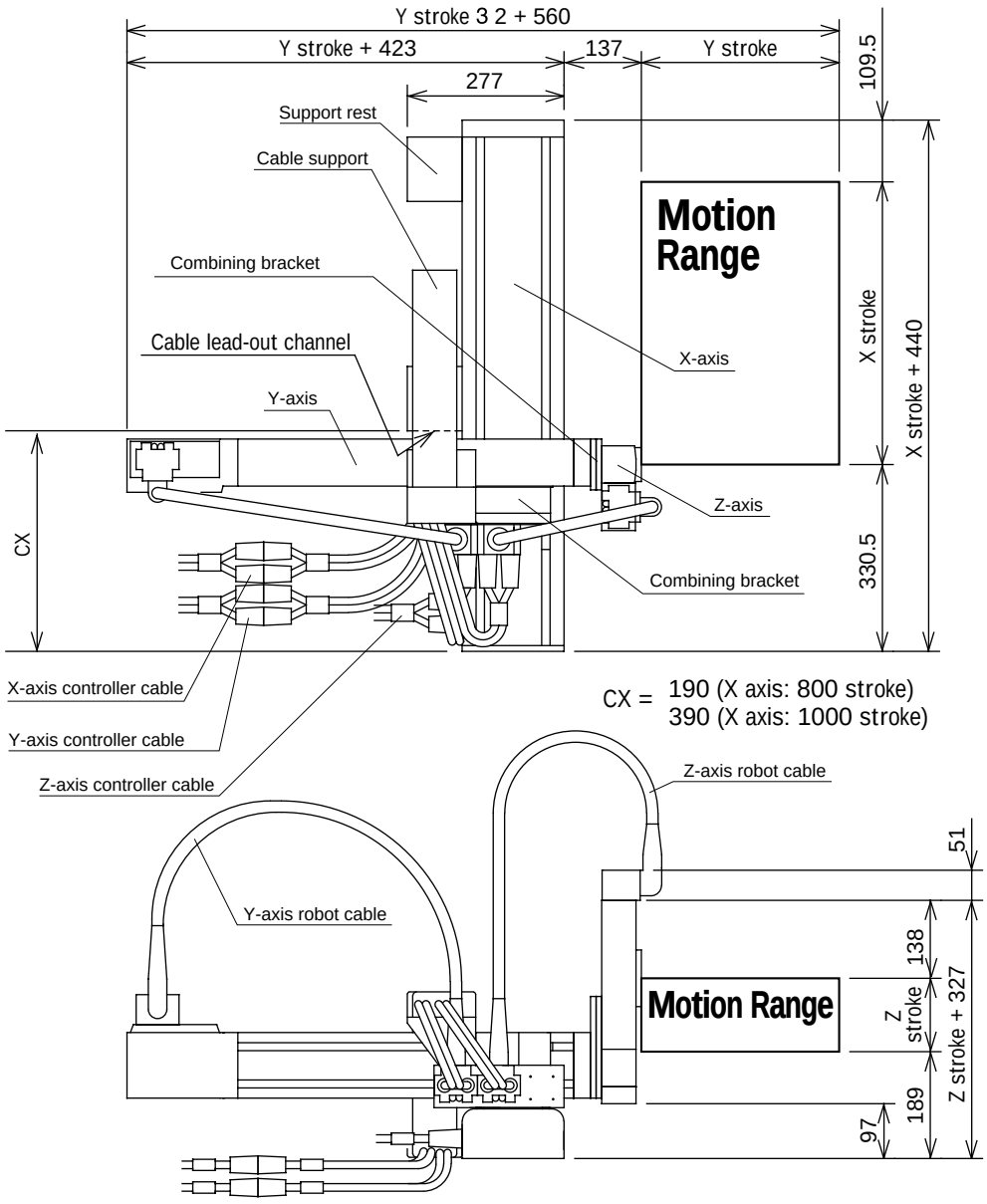


	Z stroke [mm]	250	350	450	550
Transportable load [kg]	130	15	10	6	3
	230	15	9	5	2

Figure 8-46. J Slider Stroke Configuration

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J Extended Stroke Configuration



	Z stroke [mm]	250	350	450	550
Transportable load [kg]	130	10	10	6	3
	230	10	9	5	2

Figure 8-47. J Extended Stroke Configuration

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T Configuration

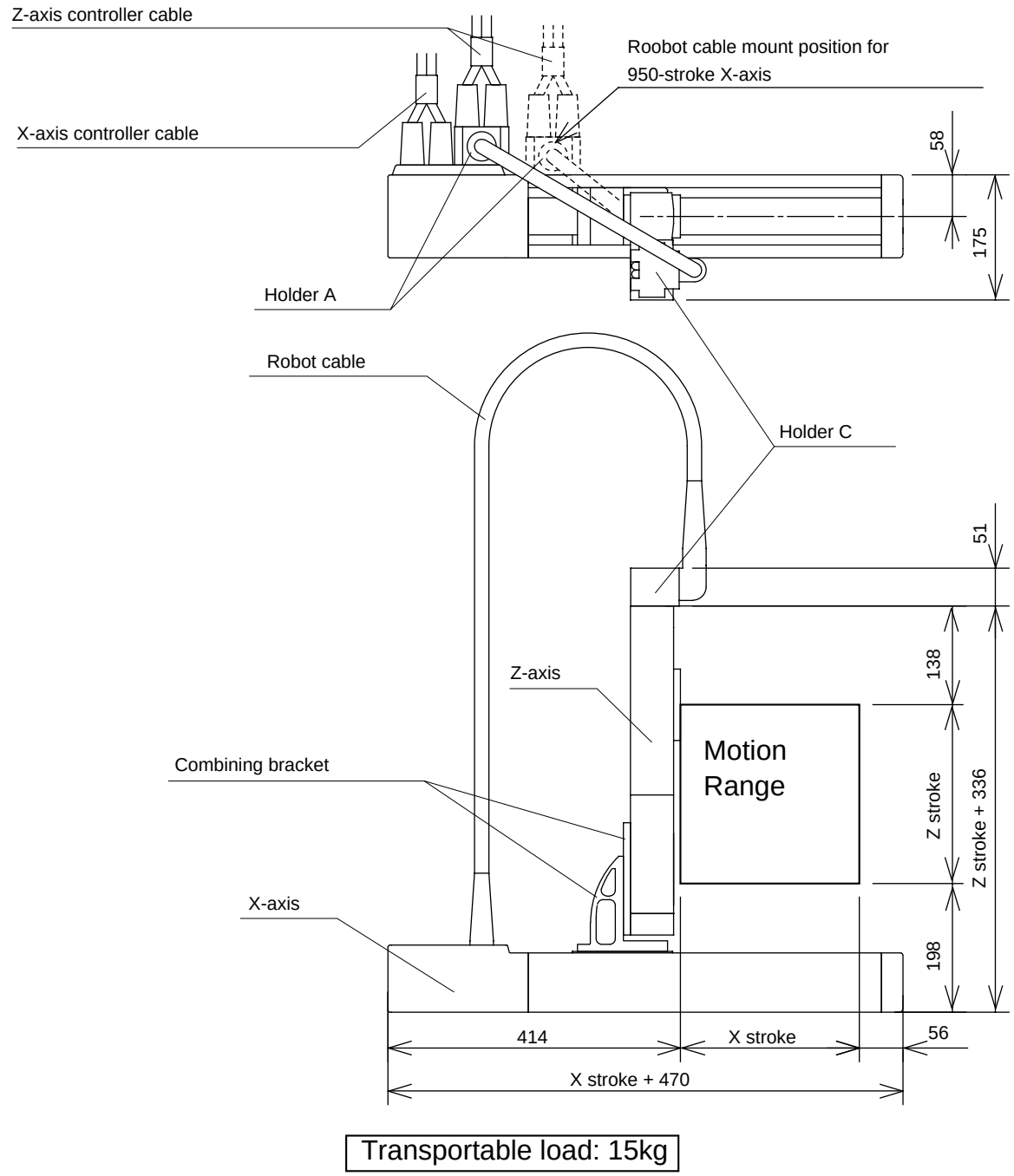


Figure 8-48. T Type Configuration

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Adept Cartesian Robot

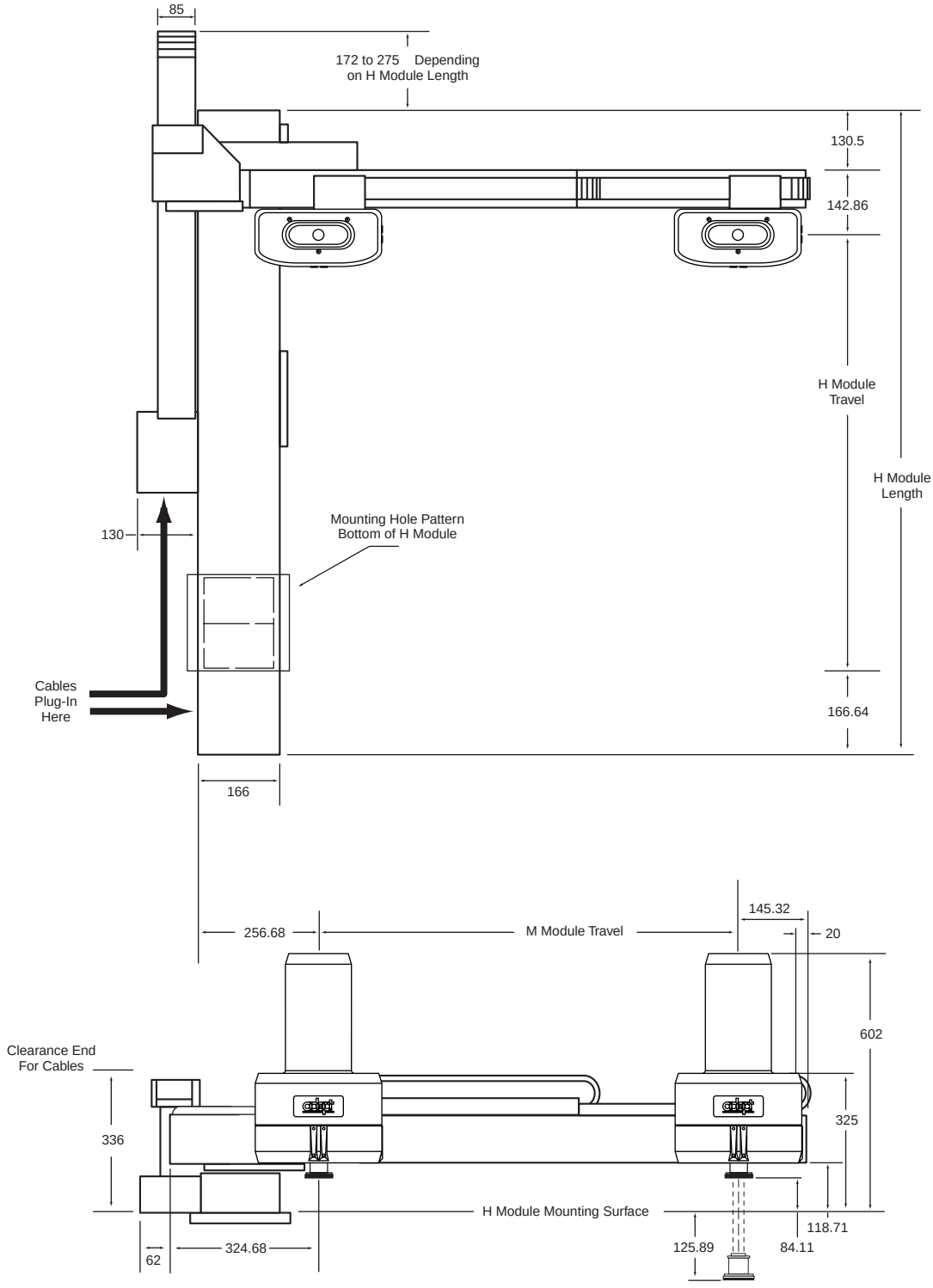


Figure 8-49. Adept Cartesian Robot

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CleanRoom Modules A

Introduction **251**
Difference **251**
Maintenance of Cleanroom Models **251**

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A.1 Introduction

AdeptModules are available in cleanroom models which meet Class 10 specifications. The following is a description on how the cleanroom model differs from that of the standard model.

A.2 Difference

In all aspects, the dimensions of the cleanroom models are the same as the standard models. The cleanroom models, however, have two vacuum connections on one end of the module. These allow for the removal of particles from within the module during operation.

Cleanroom models also have different seal belts. This belt seals the module tighter than the standard model belts, thus preventing particles from escaping from the module.

The cleanroom quality may decrease as the speed of the module increases. The modules are guaranteed to meet class 10 specifications only at a maximum speed of 400 mm / s (this value includes a small safety margin), with a vacuum flow rate of 60 L / min. If the vacuum flow rate is increased to 90 L / min, the module speed may be subsequently increased to 600 mm / s.

A.3 Maintenance of Cleanroom Models

The only real difference in maintenance between cleanroom and non-cleanroom is the type of grease that is used. Shell Alvania LG2 (Pt# 90401-04029) grease is recommended for use in the cleanroom modules.

Another check that must be performed is that all vacuum lines are secure and that the right amount of vacuum is present (60 L / min).

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Reversing Motor Mounts B

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B.1 Introduction

For some applications, a side-mounted motor must be moved to the other side of the module. The following procedures explain how to swap the motor position on an Sz-Module. Pay special attention to the Notes for valuable information that will help in swapping the motor.

B.2 Procedure

The following is a step-by-step procedure on swapping the motor from one side of the module to the other. Use of the Figures and Notes will help with the process of swapping the motor.

1. Remove the four motor cover screws and pull off the motor cover (see Figure B-1).

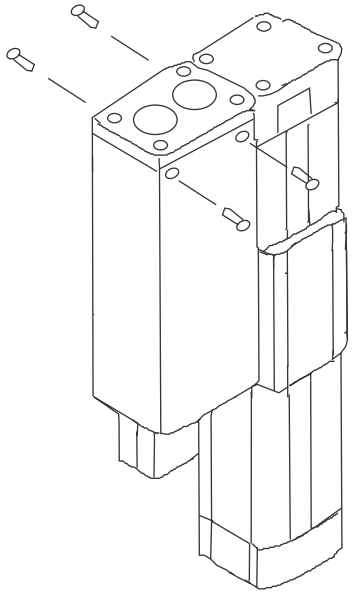


Figure B-1. Motor Cover Removal

2. Remove the four screws on the connector base and remove the connector base (see Figure B-2).

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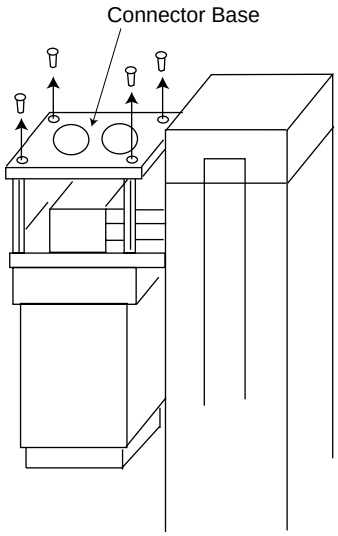


Figure B-2. Connector Base Removal

3. Remove the seal belt screw. Remove the four screws on the end cap and remove end cap (see Figure B-3).

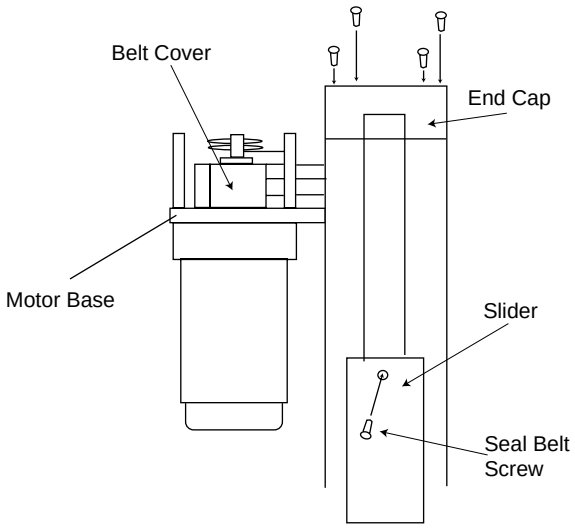


Figure B-3. Seal Belt and End Cap Removal

4. Cut the tie rap on the belt cover and remove the belt cover.
5. Using an extraction tool remove pins 4 to 7 from the thicker connector. The color of the cables are listed in Table B-1.

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Table B-1. Cable Color to Pin Number Connections

Pin #1	Grey
Pin #2	Orange and Pink
Pin #3	Blue and Yellow
Pin #4	Brown

6. Remove the four screws from the motor base plate to separate motor from the base plate (see Figure B-4).

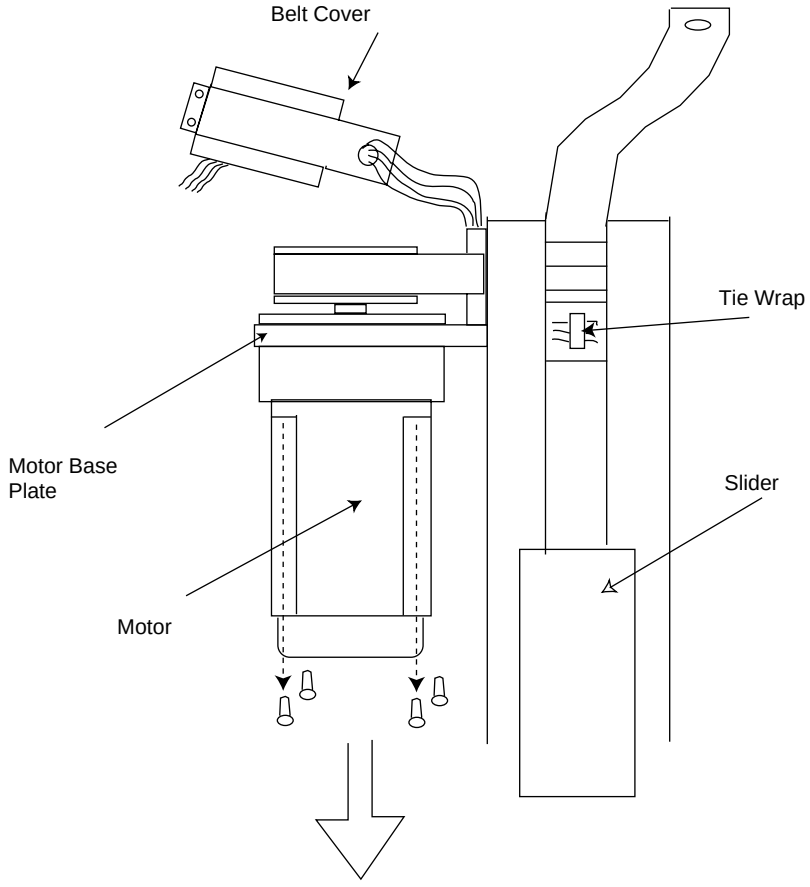


Figure B-4. Separating Motor From Base

7. Cut the tie-wrap on the module (see Figure B-4).

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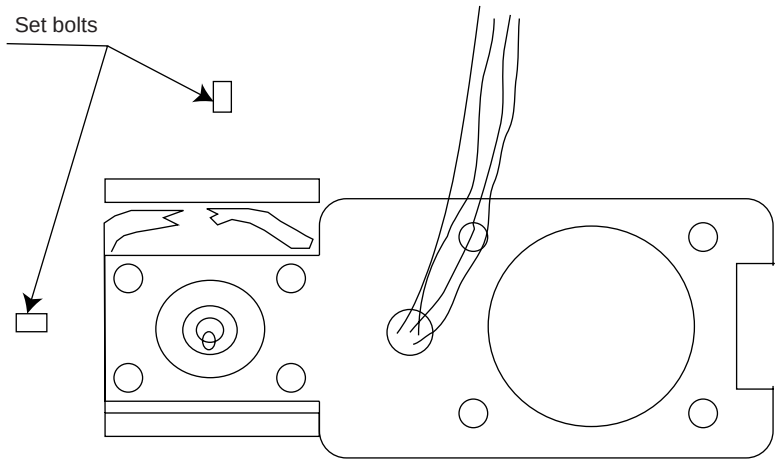


Figure B-5. Removal of Set Bolts

8. Paint a mark on the pulley (see Figure B-5).

   NOTE: This paint mark is going to be use as a timing mark. The paint mark should cross both the pulley and the motor shaft.

9. Remove the two pulley set bolts and remove the pulley (see Figure B-5).
10. Remove the wires from the base plate (see Figure B-5).

    NOTE: Mark the base plate (paint or tape) on the top to distinguish the top from the bottom (see Figure B-6).

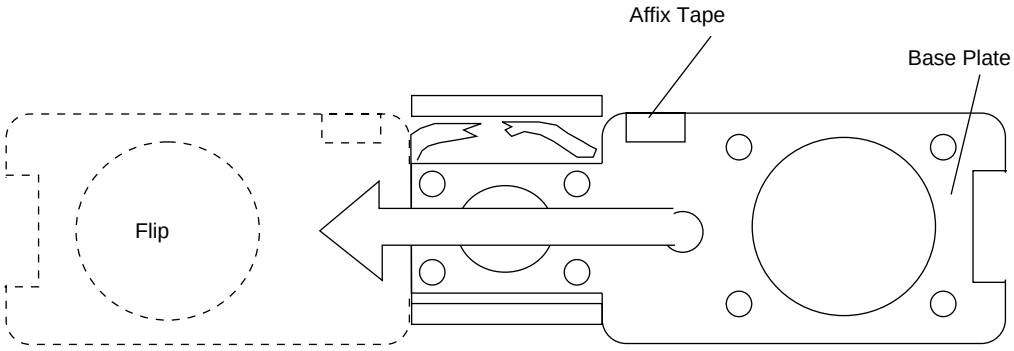


Figure B-6. Motor Mount Plate Flipping

11. Rotate the base plate to the other side of the motor (see Figure B-6).

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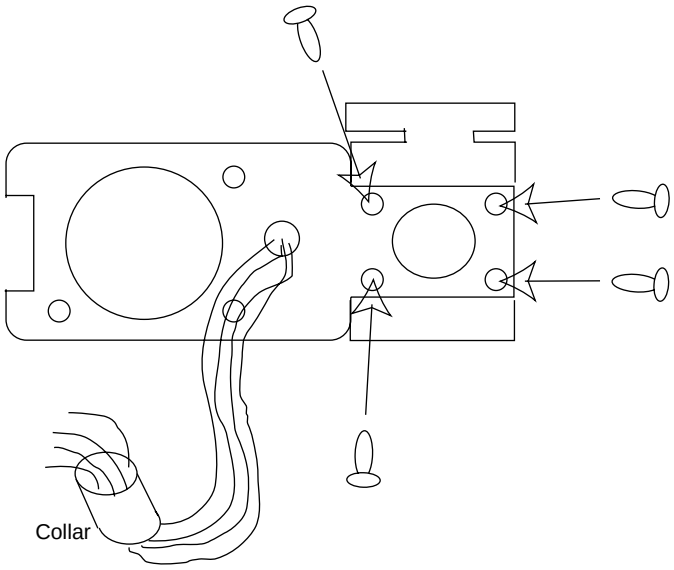


Figure B-7. Re-mounting Motor Base Plate

12. Install the base plate using the four removed screws (see Figure B-7).
13. Install the wires. Place the wires through the hole and collar (see Figure B-7).
14. Install the pulley (see Figure B-8).

    NOTE: Ensure that new shims are use when installing the pulley.

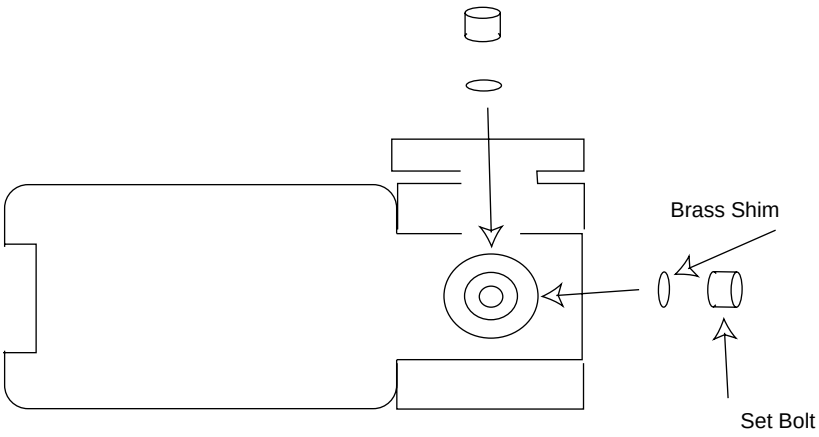


Figure B-8. Installation of the Pulley

15. Install the motor and drive pulley (see Figure B-9).

    NOTE: Ensure that the timing marks that were painted in step 8 are aligned when installing the pulley.

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NOTE: Tighten the drive belt tension between 4 and 4.5 kgf (10 in. lbs.).

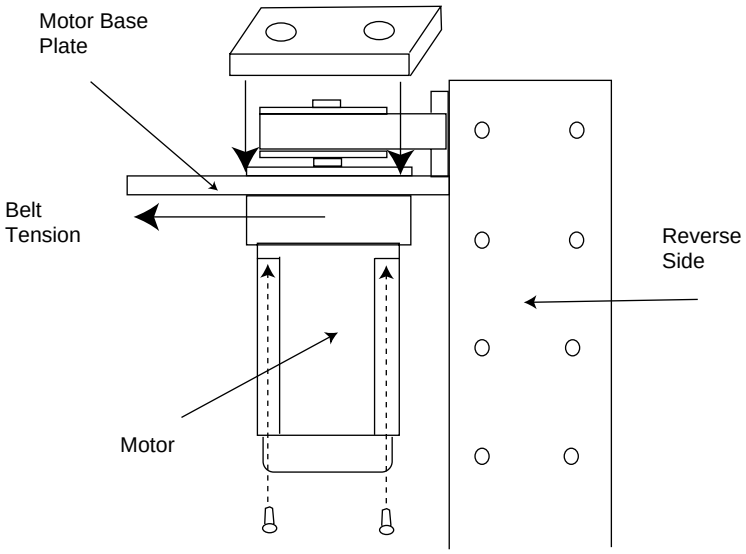


Figure B-9. Motor Installation

16. Install the belt cover (see Figure B-10).

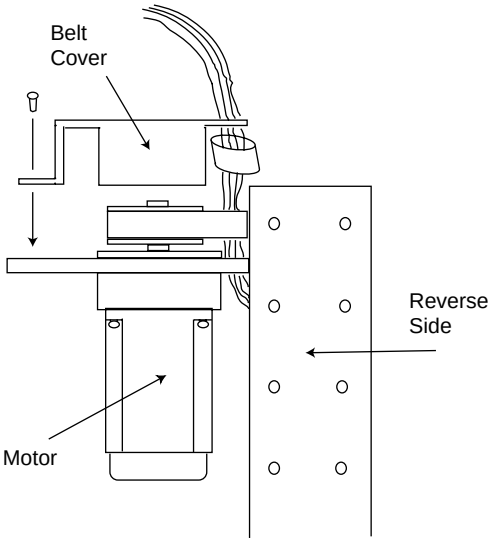


Figure B-10. Belt Cover Installation

17. Install the four stand-offs (see Figure B-11).

NOTE: Tighten by hand only (never use any type of tool to tighten stand-offs).

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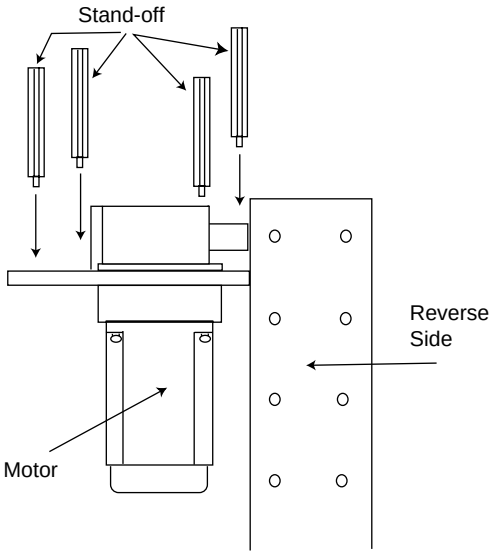


Figure B-11. Stand-off Installation

18. Using an insertion tool, insert the four removed wires into the connector (refer to Table B-1 for pin numbers).
19. Tie-wrap the wires on the belt cover (see Figure B-12).

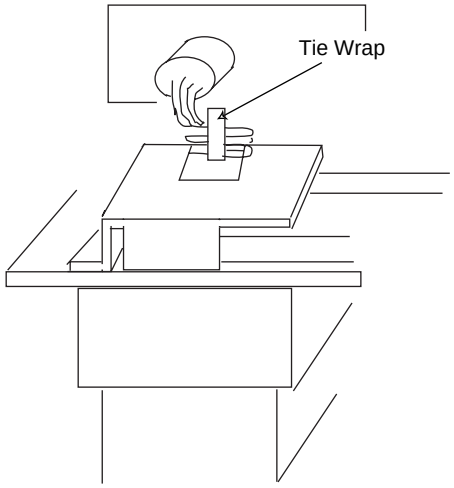


Figure B-12. Tie Wrapping Wires

20. Install the connector base on the four stand-offs (see Figure B-13).

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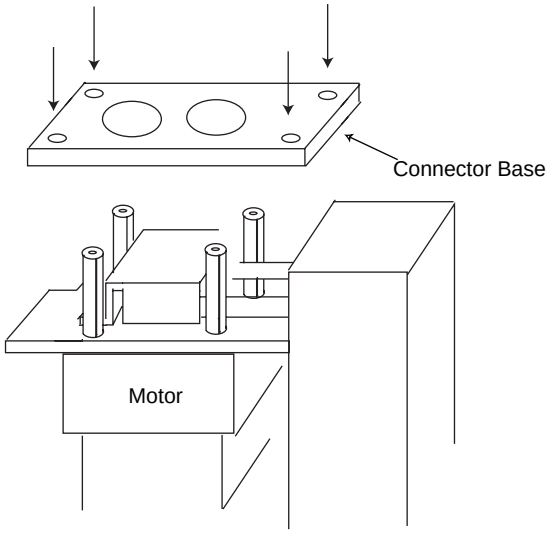


Figure B-13. Reinstalling Connector Base Plate

21. Installation of the end cap (see Figure B-14).
    a. Remove the plastic piece from the end cap.
    b. Insert the seal belt into the end cap.
    c. Install the plastic piece.
    d. Fix the end cap to the module with the four screws that were removed in step 1.

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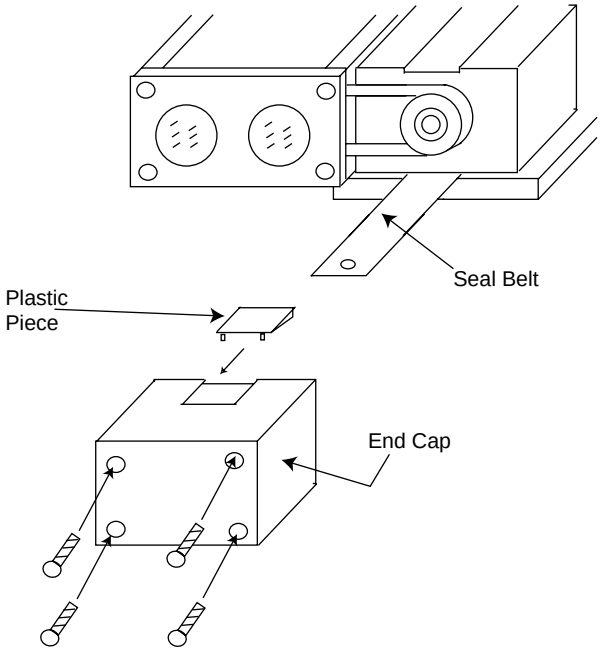


Figure B-14. End Cap Reinstallation

22. Fix the seal belt onto the slider (see Figure B-15).

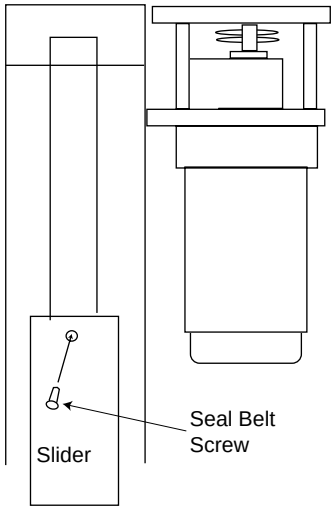


Figure B-15. Fixing Seal Belt

23. Install the motor cover (see Figure B-16).

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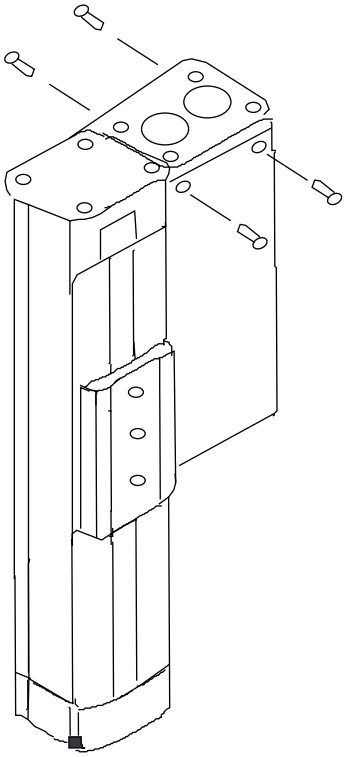


Figure B-16. Motor Cover Insertion

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Reversing Electrical Connections

C

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C.1 Introduction

In some cases the electrical connections of a direct-mount motor need to be reversed to meet the needs of the application. This section describes how to perform the electrical connection reversing process.

C.2 Procedure

1. Remove the four screws on the connector mounting panel (see Figure C-1).
2. Remove the four screws on the motor end cover and remove the end cover panel (see Figure C-1.

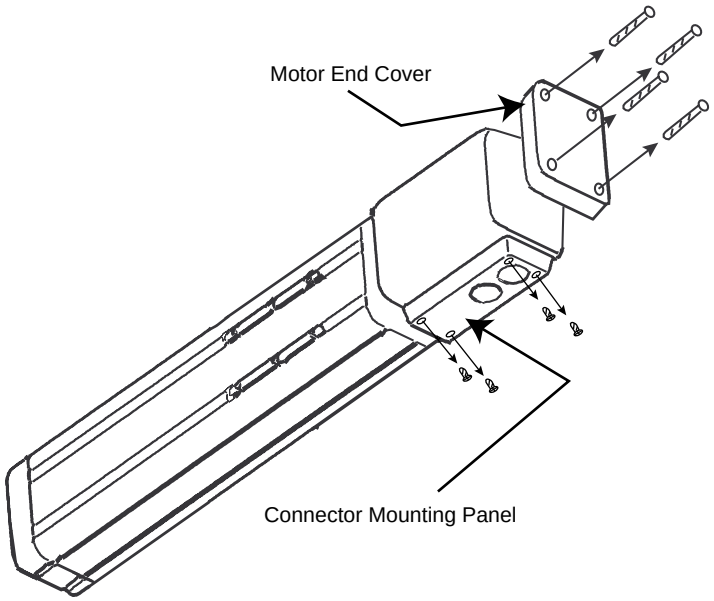


Figure C-1. Cover Screw Removal

3. Slide the connector mounting panel through the slot towards the inside of the motor cover and remove the motor cover from the module (see Figure C-2).

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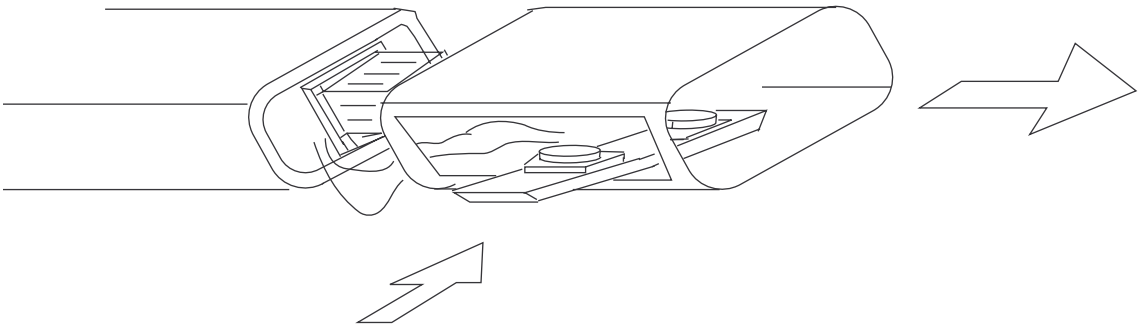


Figure C-2. Removing the Motor Cover

4. Flip motor cover over (see Figure C-3).

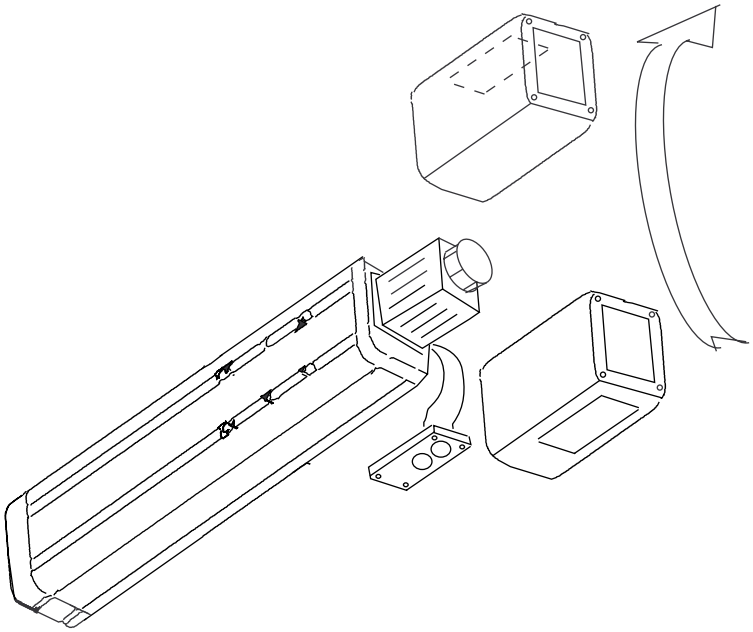


Figure C-3. Motor Cover Flipping

5. Slide the connector mounting panel through the slot toward the outside of the motor cover as shown in Figure C-4).

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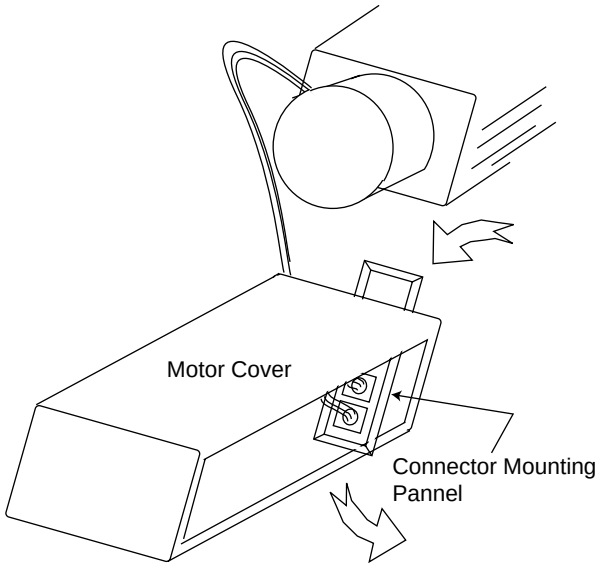


Figure C-4. Re-inserting Connector Cover Panel

6. Attach the motor cover and the motor end cover to the module with the four long screws as shown in figure Figure C-5).

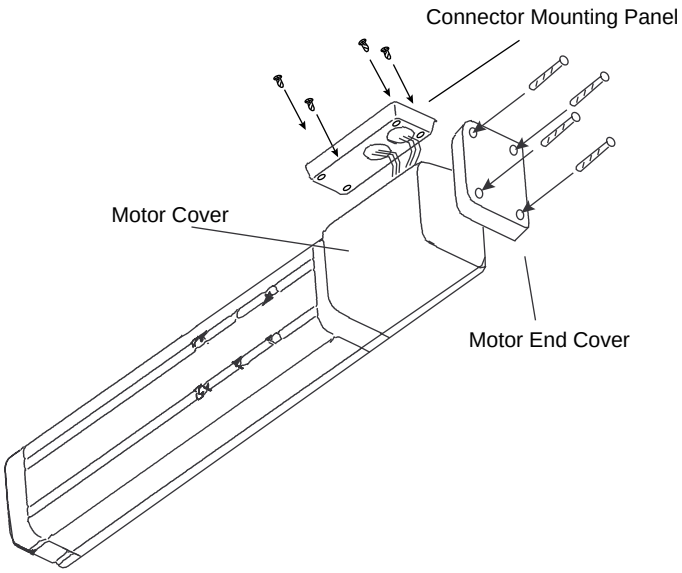


Figure C-5. Attaching Motor Cover and Connector Cover Panel

7. Attach the connector mounting panel to the motor cover using the four shorter screws as shown in figure Figure C-5).

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