GRIFFIN MOTION

User Manual

CXY, Standard Options

Document Notice

This manual contains pertinent safety information for the proper integration, use, maintenance, and decommissioning of certain CXY motion products provided by Griffin Motion, LLC. Please first verify the applicability of this manual to the equipment in use prior to following its guidance. If you have any questions whatsoever, please do not hesitate to reach out to a Griffin Motion representative.

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This manual is subject to change without notice and is superseded by any new revision. All previous and current revisions of this manual may be made available upon request.

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2 SCOPE

2.1 FOREWORD

This manual contains product information for a broad range of offerings, under the designation “CXY”. With the intent to provide a more concise user manual, most illustrations and figures depict a standard configuration (Griffin Motion Part Number: CXY-C-150-BS-A-H-S-0-00) which has features that can be applied across the entire product lineup. For situations where major deviations exist, a note or additional figures are provided. If you are unsure of any information provided or how it may apply to your product or requirements, please contact a Griffin Motion representative.

In addition, through continual improvement of its products, Griffin Motion may change the listed ordering options or make small changes to the stated specifications without notice. For previous customers, the best point of reference for your equipment is the documentation you had received at the time of your delivered order.

2.2 INTENDED USE

This product manual is intended for use by a qualified technician or knowledgeable system integrator.

The CXY series of dual axis table stages are intended for use in a laboratory or light industrial application. A typical use environment for a CXY is in a temperature-controlled room that is free of dirt, oil, and condensing moisture.

A CXY’s intended primary purpose is to provide high precision positioning and adjustment of externally mounted shifting loads within its designed machine limits. Implementation examples include, but are not limited to, microscope inspection machines, laser engraving, 3d printing, automatic dispensing equipment, and general-purpose positioning. Safety guidance and installation procedures in this manual are strictly related to the positioning capabilities of the CXY, and not the applied use thereof.

In its primary configuration, a CXY is intended to be used with both of its axes horizontally aligned lying flat like a table. The stage may operate in any other orientation; however, those scenarios must be fully assessed where additional factors, such as the effect of gravity, are properly compensated to preclude damage to the stage or attached equipment.

Where not provided directly from the manufacturer, suitable controls and cabling should be selected or manufactured to control the various aspects of the stage to provide maximum safety of the equipment and any potential user. Moreover, the CXY was designed to be integrated into a control system with the intent of hands-free operation requiring no direct human intervention while the device is energized. Simply complying with the hazards and caution notices of this manual may not satisfy the regulatory requirements of your intended application or your jurisdiction.

2.3 HAZARDS AND WARNINGS

This user manual, when followed by a knowledgeable person, will direct an individual on how to safely install, operate, or service this stage. It is required that the user of a CXY stage strictly adhere to the provided instructions and guidance provided in this manual and perform risk evaluations where this manual does not cover a specific end-user application. If any portion of the information provided herein is not understood, please contact a Griffin Motion representative.

A list of identified human and machine safety factors directly related to the operation of a CXY are compiled below. While guidance is provided below for the identified hazards, it may not be sufficient to adequately identify, reduce, or remove the risks associated with a specific user application; therefore, a risk assessment of your intended application against the applicable standards in your local jurisdiction must be conducted prior to use.

DANGER: This product may contain potentially lethal voltages. To reduce the risk of shock to a human operator, the following precautions must be followed:

1. Controllers and cables fully de-energized prior to connecting to the stage.
2. De-energize and disconnect power sources before servicing.
3. Use an appropriate grounding scheme to preclude accidental shock under fault conditions.
4. Install control systems that can detect fault voltages and provide an alarm.
5. Where direct human intervention is expected during operation, install additional non-conductive safety guards or power interruption equipment (e.g. sensor curtain) to de-energize the equipment as required.
6. Create and post operating instructions and warning labels on the final equipment.

DANGER: This product contains crushing and shearing hazards. To reduce the risk of crushing or shearing, the following precautions must be followed:

1. Install equipment as outlined in mechanical installation chapter.
2. Install shipping locks during transport or relocation of equipment.
3. Where potential for touching is expected during operation, perform some or all of the following, depending on the application:
    a. Install additional warning labels.
    b. Install additional guards or enclose the equipment.
    c. Install a power interruption control system (e.g. sensor curtain) to de-energize the equipment.
4. For control systems, consider lowering motor currents as low as practical.
5. Create and post operating instruction and warning labels on the final equipment.

CAUTION: This product may produce potentially hazardous temperatures. To reduce the risk of burns to a human operator, the following precautions must be followed:

1. Where potential for touching is expected during operation, perform some or all of the following:
    a. install temperature warning signs on motor housings
    b. install temperature monitoring equipment or additional thermal guards.
2. Control systems shall monitor for overcurrent conditions.
3. Control systems shall monitor for overvoltage conditions.
4. Create and post operating instructions and warning labels on the final equipment.

CAUTION: This product may emit electromagnetic radiation. To reduce the risk of interference with other electrical equipment, the following guidance may apply:

1. Assess the motor amplifier topology in your control system.
2. Construct shielded motor cables and feedback cables as outlined in this user manual.
3. Create RF shields for any other sensitive equipment in the vicinity of the CXY stage.
4. Contain final equipment in RF conducting meshes or enclosures.
5. Utilize filters, transformers, or other impedance equipment to mitigate radiation from power sources as outlined in supporting controller manuals.

ATTENTION: This product may emit uncomfortable noise levels depending on how it is operated. To reduce the discomfort level due to radiated noise, the following guidance may apply:

1. Change the motor amplifier topology.
2. Re-tune the current control loop gains in the amplifier.
3. Isolate the equipment with a sound barrier.
4. Turn off machines that are not required to be in operation.
5. Limit the amount of time operators are in the vicinity of equipment.

ATTENTION: This product is intended to be incorporated as part of a complete control system; some, key operating factors and control system considerations are listed:

1. Warn user of abnormal machine operation.
2. Secure power to machine when an unsafe condition exists.
3. Arrest or halt motion as required.
4. Prevent unexpected start-up or motion.

3 PRODUCT OVERVIEW

3.1 ORDERING OPTIONS

This product manual contains information applicable to the CXY products in the series as outlined in Table 1. If there are any ordering options that do not fit your set of requirements, please contact a Griffin Motion representative who may then provide clarification or information regarding our other offerings that could best suit your needs.

Table 1. Ordering Options

Example Part Number								
CXY	C	050	BS	A	M	S	0	00
Part Number Ordering Options								
Product Series	**Aperture**	**Travel of both axes (mm)**	**Drive Type**	**Motor Type**	**Encoder Type**	**Precision Level**	**Additional Option**	**Custom Option**
CXY – Dual-axis table stage	C – Closed Aperture	050	BS – 2mm ball screw	A – Nema17 Brushless DC	H – rotary quadrature encoder	S – Standard	0 – no additional options	00 – no custom options
		100	BF – 5mm ball screw ***(Note 1)***	M – Nema17 Long stack Brushless DC ***(Note 1)***	M – linear quadrature encoder	P – High ***(Note 1)***	D – Power off brake	Any other value 01 through 99 ***(Note 1)*** ***(Note 2)***
		150			L – linear sinusoidal encoder ***(Note 1)***		C – Clean room Prepped ***(Note 1)***	
		200					V – Vacuum Prepped ***(Note 1)***	

Note 1: Non-typical options are noted for user information. These setups may include various alterations that may incur additional requirements not fully covered in this technical manual; an amended user manual, addendums, technical drawings, and other supporting documents will be provided with these orders. Please contact a Griffin Motion representative if you need document support for these ordering options.

Note 2: Some Griffin Motion products have been evaluated to meet specific regulatory requirements. If your application requires proof of compliance to any standard, please inquire with a Griffin Motion representative. Please be aware that inclusion of regulatory examples in this manual do not prove compliance; an appropriate certificate will be provided at the time of order fulfillment.

Figure 1. Example Compliance Standards

3.2 ENVIRONMENTAL SPECIFICATIONS

Operating and storage environment consistent with Table 2.

Table 2. Environmental Specifications

Operating Temperature	Indoor controlled temperature environment between 17˚C to 27˚C
Storage Temperature	Indoor long-term exposure to temperatures between -5˚C and 50˚C
Humidity	15% to 85% relative humidity, non-condensing
Altitude	0ft to 6000ft above sea level
Vibration	Low Vibration Environment
Protection Rating	IP10
Use	Partly assembled machine intended for indoor use, properly integrated as part of a control system; no direct human contact expected while in operation. Used by a trained operator or integrator.

3.3 BASIC SPECIFICATIONS

Some of the orderable CXY stage configurations are shown in Table 3. Note that not every permutation of the orderable options of Section 3.1 are provided; please contact a Griffin Motion representative with your inquiries with regard to an ordering configuration not listed.

Table 3. Basic Product Specifications for CXY-C-*- BS-A-***-S-0-00**

Stage Travel	**50 mm**		**100 mm**		**150 mm**		**200 mm**	
Encoder Type	Rotary	Linear	Rotary	Linear	Rotary	Linear	Rotary	Linear
Height (mm)	66							
Length (mm)	266	247	320	297	366	347	416	397
Width (mm)	209	208	265	259	311	309	360	359
Limit Switches	Positive, Negative, (center Home for Rotary Encoder)							
Encoder Output	RS422, Quadrature (A/B/Index)							
Encoder Resolution (µm)	0.125	0.1	0.125	0.1	0.125	0.1	0.125	0.1
Stage Mass (kg)	6.23		9.35		13.57		17.93	
Moving Mass X (kg)	4.15		5.88		9.08		11.61	
Moving Mass Y (kg)	1.22		2.32		3.59		4.79	
Linear Velocity (mm/s)	140		140		140		140	
Force X/Y, Continuous (N)[1]	165							
Force X/Y, Peak (N)[1]	330							
Force Z (N) [1]	400							
Moment X (N·m) [1]	80				110			
Moment Y (N·m) [1]	80				110			
Moment Z (N·m) [1]	50				75			
MTBF (hours)[2]	20000							

Note 1: Refer to Figure 2 for axis orientation for force values.
Note 2: Expected life provided that a CXY is employed in a reasonable application of its intended use at moderate velocities, payloads, and duty cycles with respect to the stated limits. For high duty cycles or OEM applications requiring extra data, please contact a Griffin Motion representative.

Listed accuracy specifications assume the stage is mounted in a similar fashion and environment to which it was tested at the factory. The factory test environment is a 20C air-temperature controlled room with the stage mounted on a stable granite surface.

Every unit is tested and verified to the specifications listed above and provided with a formal test report. Interferometry testing is conducted at a nominal 35 mm spacing above the loading plate on the stage.

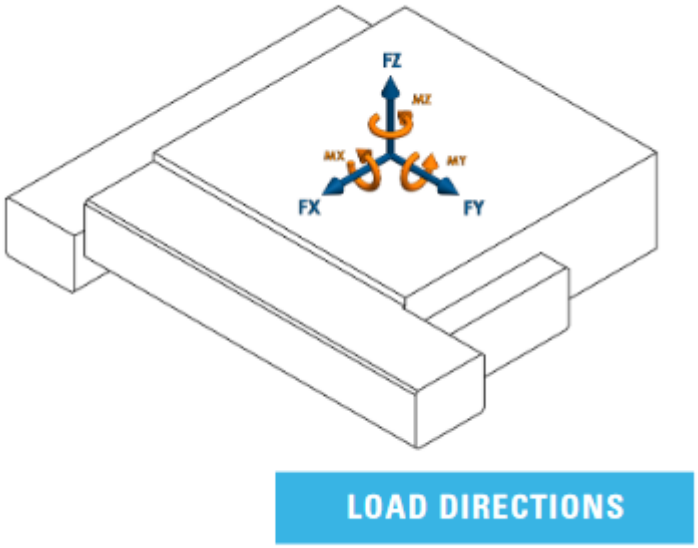


Figure 2. CXY Load Direction Reference

3.4 PRODUCT VIEWS AND LABELS

3.4.1 NOMENCLATURE

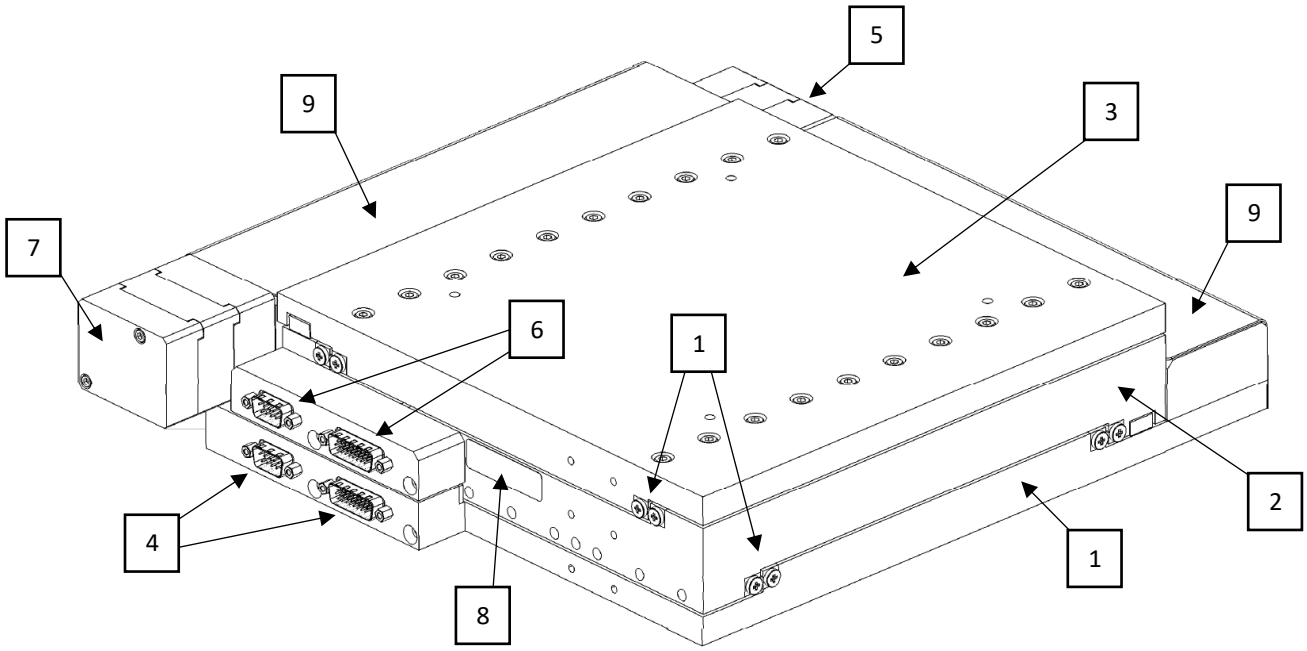


Figure 3. Generic CXY View

1. Baseplate
2. Compound Plate
3. Payload Plate
4. Bottom Axis, Connectors for Motor and Feedback
5. Bottom Axis, Motor Housing
6. Top Axis, Connectors for Motor and Feedback
7. Top Axis, Motor Housing
8. Product Series and Serial Number Label
9. Ball-screw Covers
10. Linear Bearings

3.4.2 VIEW OF MECHANICAL HAZARDS

DANGER: Due to the intended design of the CXY, there exists pinch points (as pointed out in Figure 4) that are unavoidable. De-energize the equipment whenever direct human contact with the CXY stage is required. Labels are not provided on the product for this specific hazard; depending on your intended use, labels may be required to be affixed to the machine locations highlighted below.

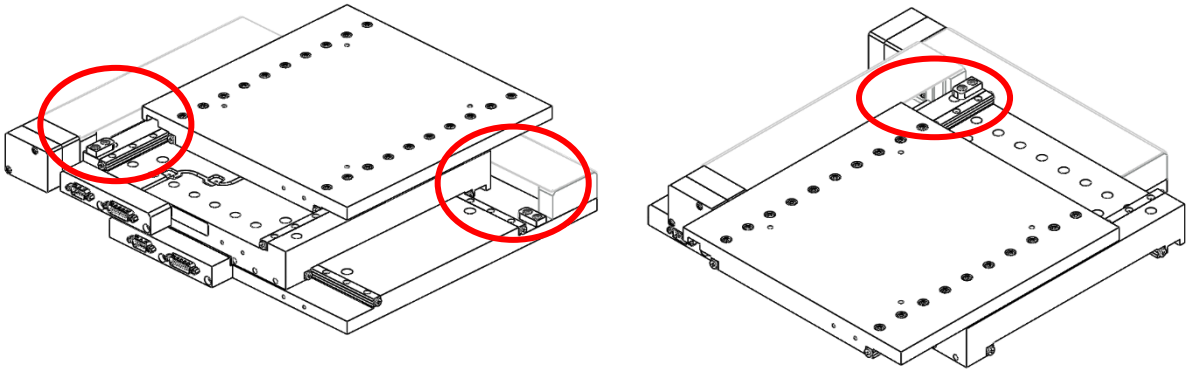


Figure 4. CXY Pinch Point Hazard Locations

CAUTION: If motor current is not monitored properly, the housings (as pointed out in Figure 5) may reach temperatures that could burn an operator during operation or service. Labels are not provided on the product for this specific hazard.

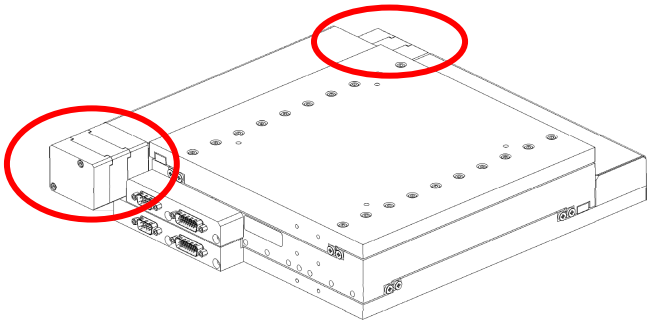


Figure 5. CXY High Touch Temperature Hazard Locations

3.5 DIMENSIONS

The sub-sections of this chapter will illustrate the primary dimensions of the different sizes a CXY may come in. Illustrated are the overall dimensions of the product, loading plate patterns, and mounting patterns.

3.5.1 CXY-C-050 DIMENSIONS

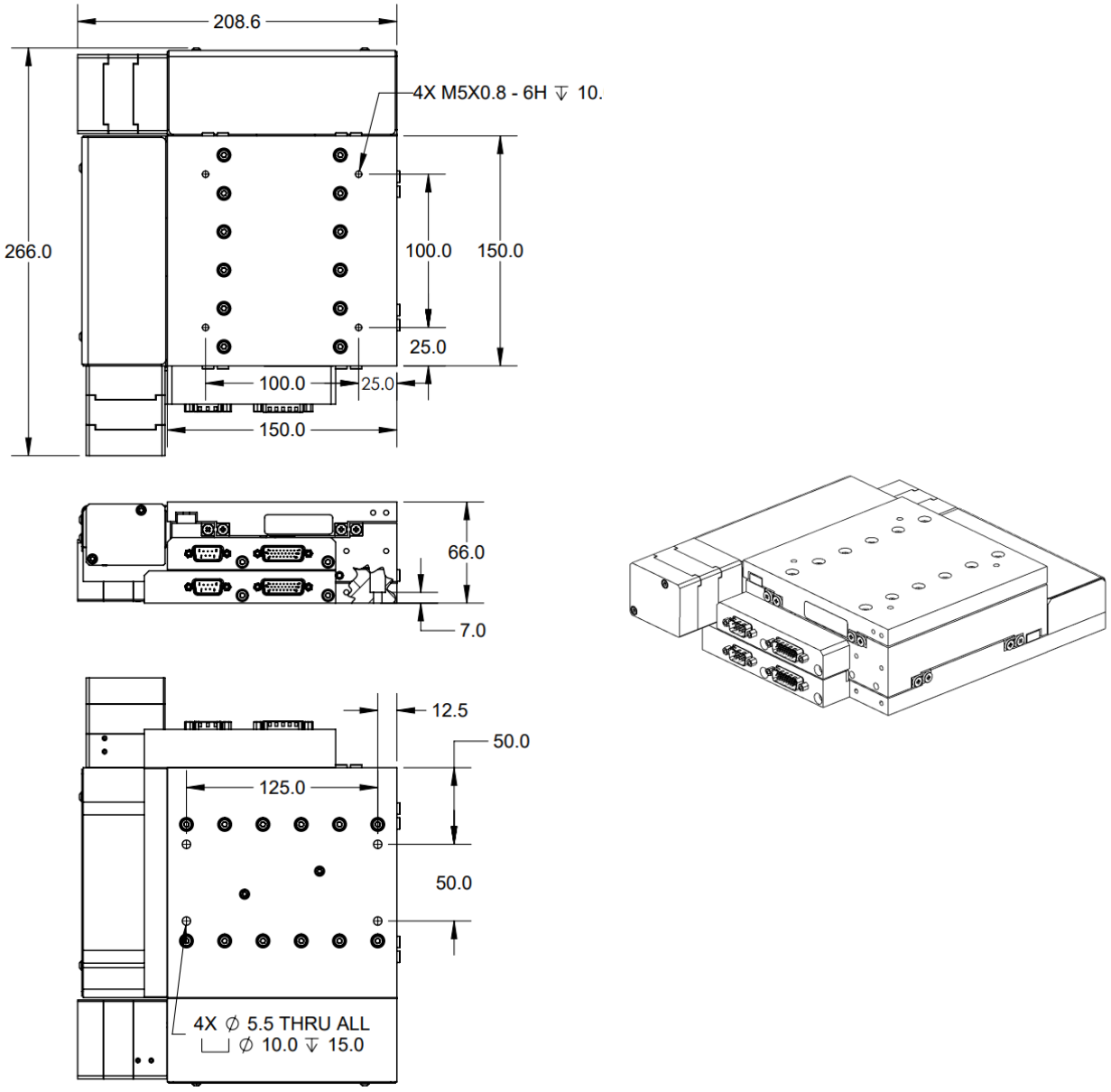


Figure 6. CXY-C-050-* Product Dimensions**

3.5.2 CXY-C-100 DIMENSIONS

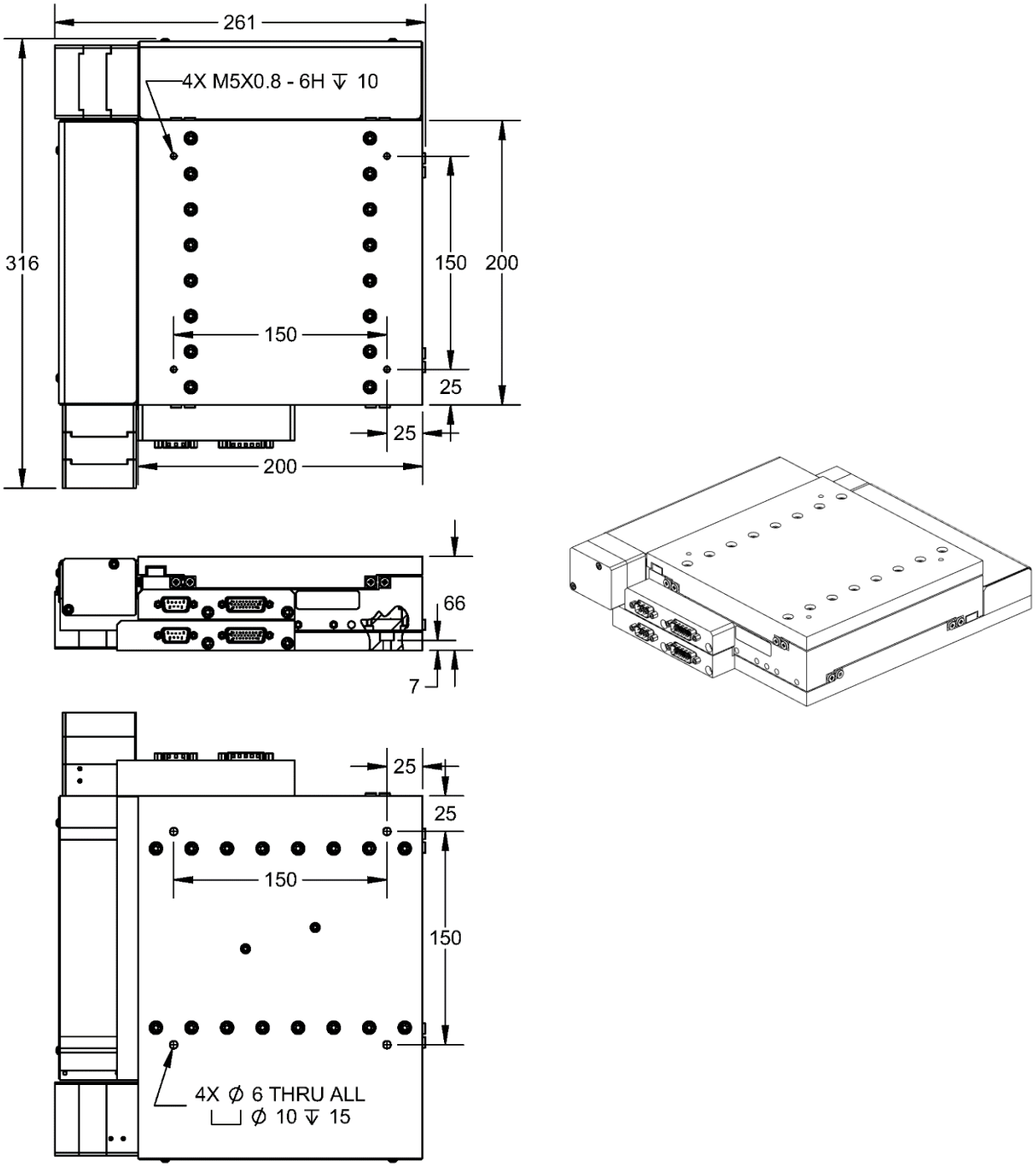


Figure 7. CXY-C-100-* Product Dimensions**

3.5.3 CXY-150 DIMENSIONS

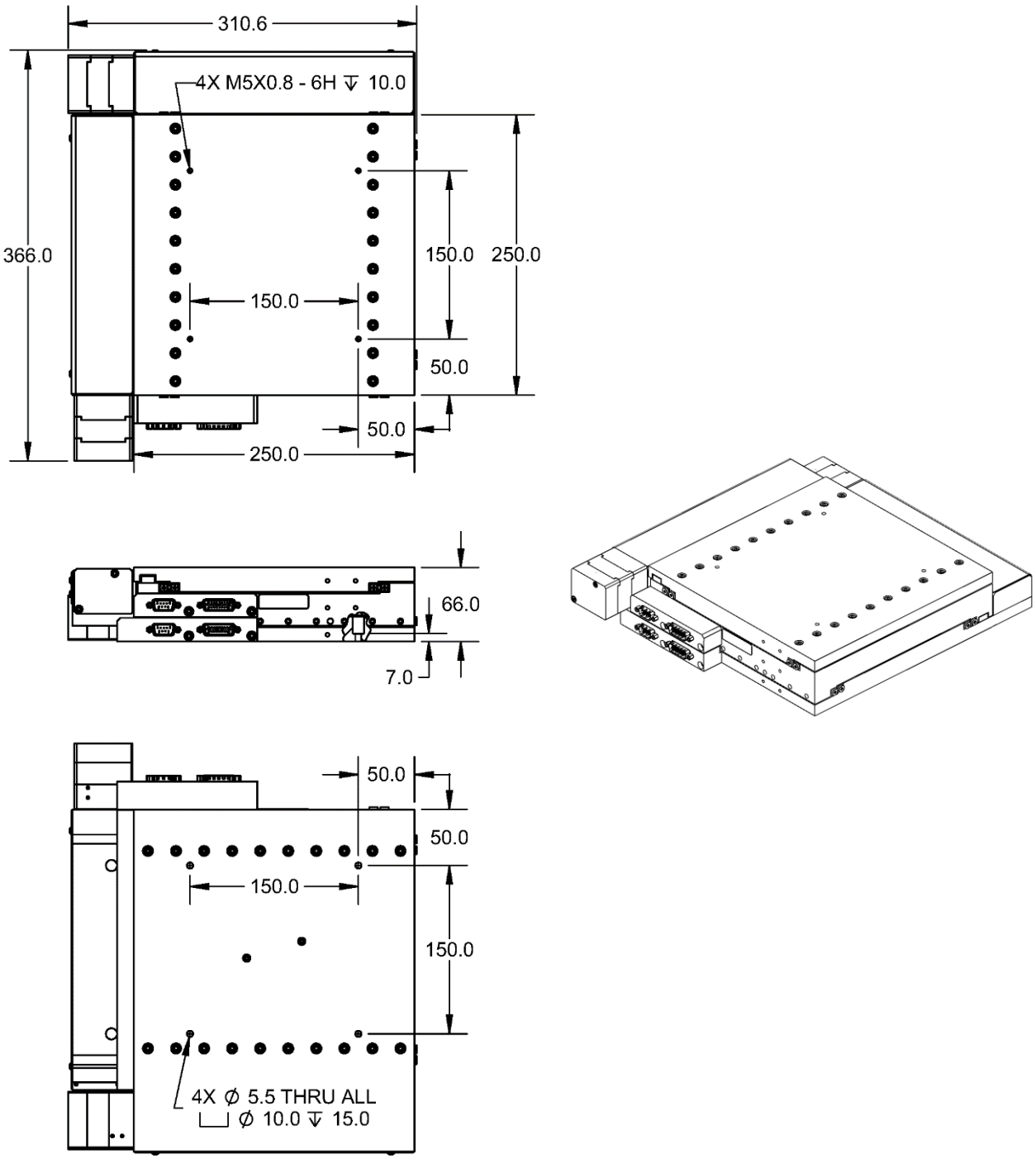


Figure 8. CXY-C-150-* Product Dimensions**

3.5.4 CXY-C-200 DIMENSIONS

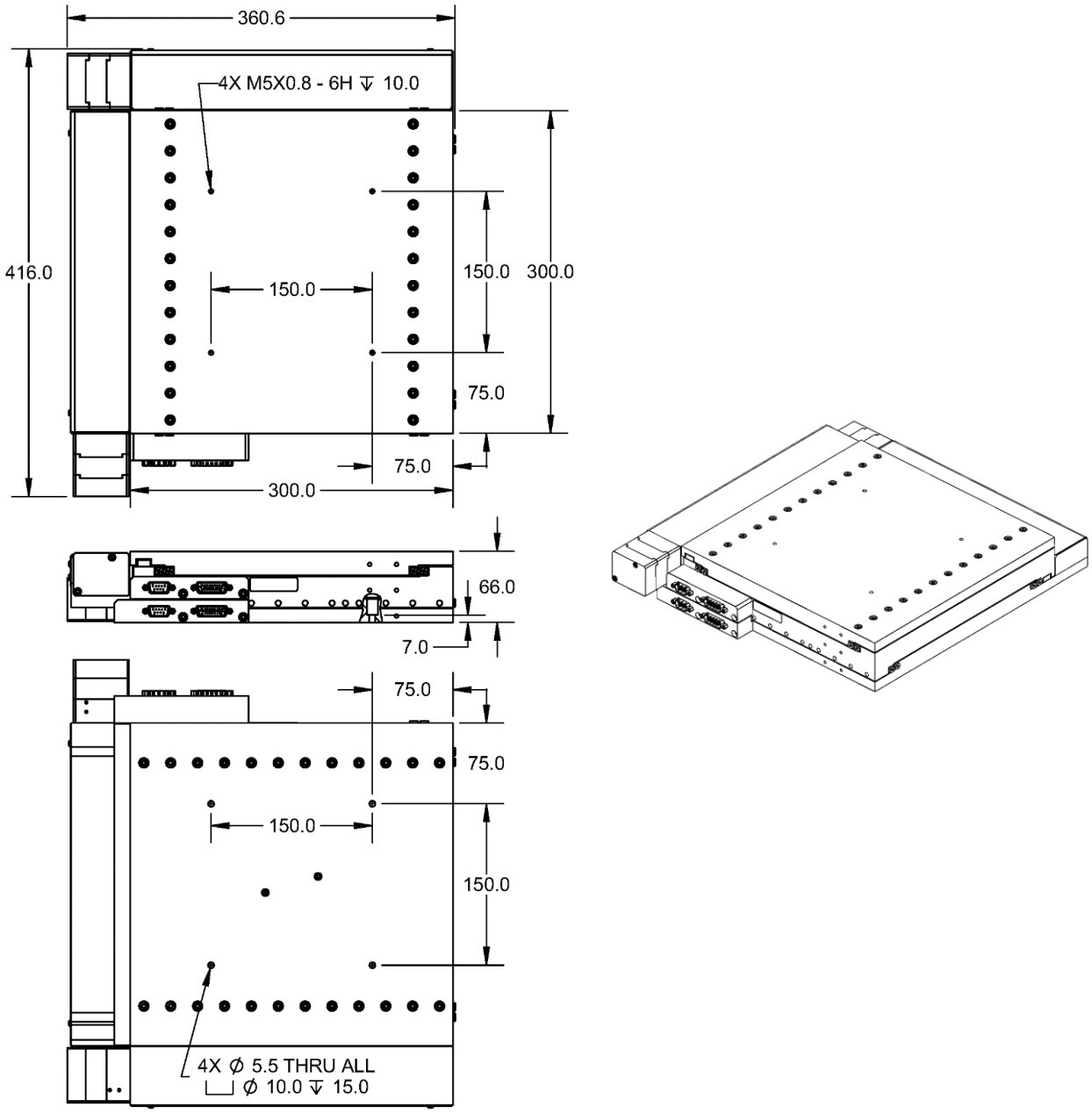


Figure 9. CXY-C-200-* Product Dimensions**

3.6 ELECTRICAL SPECIFICATIONS

3.6.1 MOTOR SPECIFICATIONS

The motor specifications of Table 4 are for the standard Motor Ordering Option "A", NEMA17 3-phase brushless DC motor.

Table 4. Standard NEMA17 Servo Motor Specification

Motor Type	3 phase Brushless DC
BEMF Constant (V/Krpm)	2.57
Electrical Time Constant (msec)	0.38
Bus Voltage (Vdc)	24 Nominal (100 max)
Max Continuous Current (A_{pk})	3.36[1]
Motor Force Constant (Nm/A_{pk})	0.0216
Peak Current (A_{pk})	6.73
Pin to Pin Inductance (mH)	0.55
Pin to Pin Resistance (ohm)	1.51
Poles per Revolution	6
Note 1: Continuous current specification assumes motor temperature rise of 80°C temperature rise above a 20°C ambient temperature environment, when the housed motor is rigidly mounted to a 300 mm x 300 mm x 25 mm aluminum heat sink.	

3.6.2 FEEDBACK SPECIFICATIONS

The basic electrical feedback specifications of the CXY are listed in the tables below for the different encoder ordering options. For proper integration with your controls, phase and signal tables are illustrated in the installation chapter, Section 0.

Linear encoder feedback, Encoder Type Ordering option "M", specifications are listed in Table 5. The linear encoder option has a center mounted, highly repeatable, index mark.

Table 5. Combined Feedback Specification (Linear Encoders)

Supply Voltage	5Vdc +/- 10%
Supply Current Max (mA)	250
Encoder Feedback Type	Incremental
Encoder Output	Square Wave Quadrature, RS-422 compatible, A, B, Z, Differential Pairs
Encoder Resolution	10000 counts / mm
Hall Switch Output Type	Open collector, no internal pullup
Hall Switch max current (mA)	-20
Limit Switch Output Type	Open collector, no internal pullup
Limit Switch Output Current (mA)	-20
Limit Switch Output Low (V)	0.8

Rotary Encoder feedback, Encoder Type Ordering option “H”, specifications are listed in Table 6.

Table 6. Combined Feedback Specification (Rotary Encoder)

Supply Voltage	5Vdc +/- 10%
Supply Current Max (mA)	250
Encoder Feedback Type	Incremental
Encoder Output	Square Wave Quadrature, RS-422 compatible, A, B, Z, Differential Pairs
Encoder Resolution	8000 counts / mm [1]
Hall Switch Output Type	Open collector, no internal pullup
Hall Switch max current (mA)	-20
Limit Switch Output Type	CMOS
Limit Switch Output Current (mA)	±20
Home Switch Output Type	CMOS
Home Switch Output Current (mA)	±20

Note 1: This value is a function of the ball screw pitch. The nominal ordering option is “BS” which is a 2mm ball screw with a 16000 counts/rev rotary encoder which translates to 8000 counts/mm.

The specifications for the power-off brake, Additional Ordering Option “D”, are listed in Table 7.

Table 7. Power-Off Brake Electrical Specification

Brake Type	Power-off engaged
Winding Voltage (Vdc) Nominal	24
Winding Current (A) Nominal	0.17
Winding Resistance (Ohm)	138

4 MECHANICAL INSTALLATION

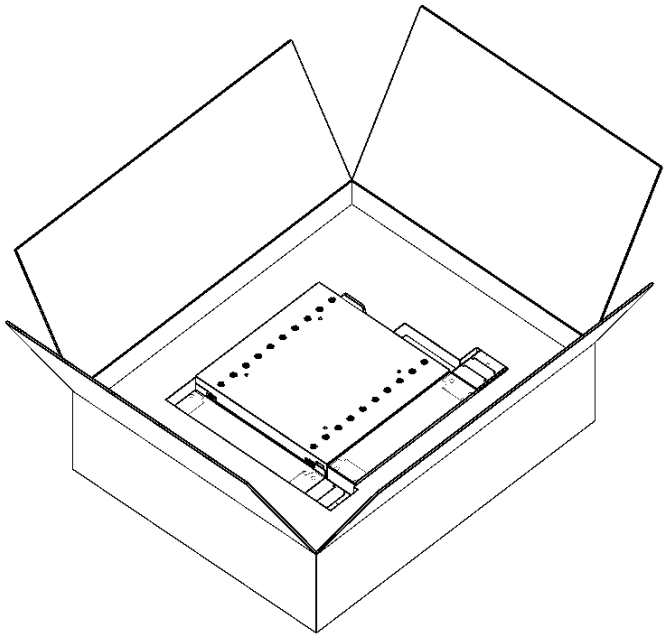
4.1 UNPACKING AND HANDLING

4.1.1 RECEIPT INSPECTION

CAUTION: A CXY stage is a very sensitive device! Handle with great care as to minimize the risk of damage to the precision surfaces, rail alignments, and feedback mechanisms.

CAUTION: Do not disassemble any portion of the equipment unless specifically directed by this user manual. Improper installation will cause the stage to no longer hold the promised accuracy specifications or cause damage rendering the device inoperable.

Prior to removal of the CXY stage from its packaging, please check the integrity of the box it was shipped in. Any excessive dirt or debris, crushed corners, or general weathering may indicate improper handling during shipment. After inspection, please verify the contents of the package for any missing materials.



Items included in packaging:

1. The CXY Stage
2. Cut-to-size foam.
3. Performance Test Report
4. Instruction manual
5. Other data sheets

Should any of these materials be missing, please contact a Griffin Motion Representative so we may convey them to you.

Figure 10. Packaging Material List and View

NOTE: Please keep all packaging materials with your equipment for a reasonable period of time. For warranty or service requests, please ship the equipment back to Griffin Motion in the original packaging.

4.1.2 REMOVAL FROM PACKAGING

CAUTION: With the shipping locks still installed, there exists a crushing risk. This is due to the weight of the CXY and the very flat surfaces all around the device. Please take care while moving the stage by hand.

CAUTION: Do not pick up, move, or manipulate the stage by grasping or holding the motor housings as indicated in red in Figure 11. The sensitive alignment of the ball screw may be affected and render the stage inoperable.

With the stage in its included plastic packaging, pick up and move the stage to a clean, stable surface using the recommended hand hold locations as shown in Figure 11.

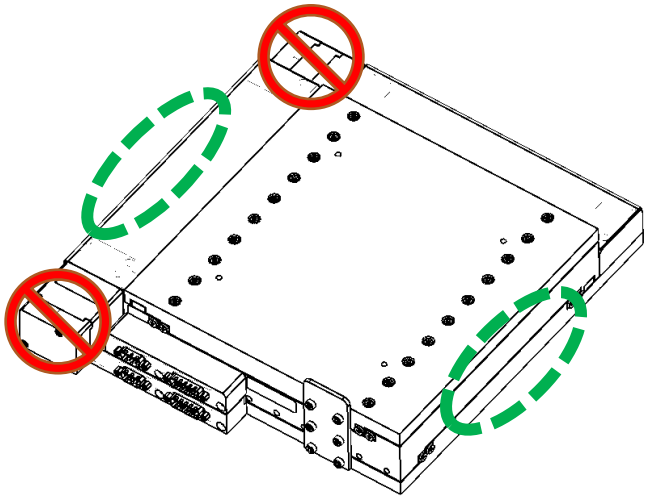


Figure 11. Recommended Handling locations of CXY, and what to avoid

Once the stage is on a stable surface, carefully remove it from the plastic packaging with clean hands or while using gloves to minimize the contamination on the bottom mounting surface.

Maintaining cleanliness is key to proper installation in its final configuration. Particles like dust and hair cannot be compressed under final torque and will cause distortion of the base plate and cause the stage to not hold promised accuracy levels.

CAUTION: During handling, install, or removal, pay attention to prevent striking the payload plate or bottom surface of the stage with tools or edges of other equipment. The nearly imperceptible surface imperfections caused by these mishaps will affect stage performance.

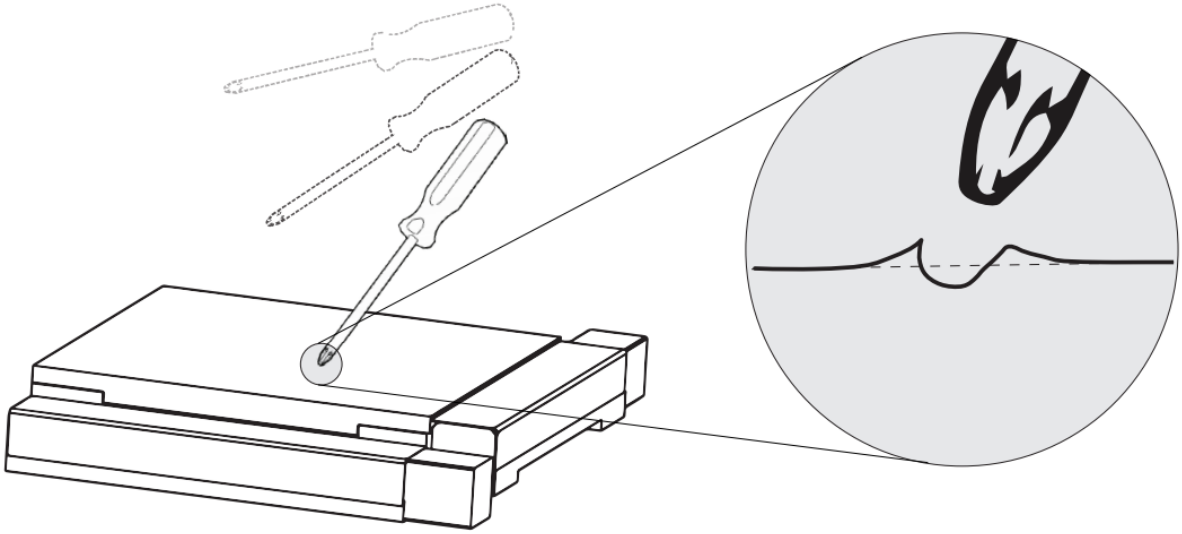


Figure 12. Damage to CXY surface due to striking

4.1.3 REMOVING SHIPPING LOCKS

Remove the red shipping lock as shown in Figure 13, by removing the 6 bolts holding the plates together. Do not remove any other bolts from the equipment other than that specified.

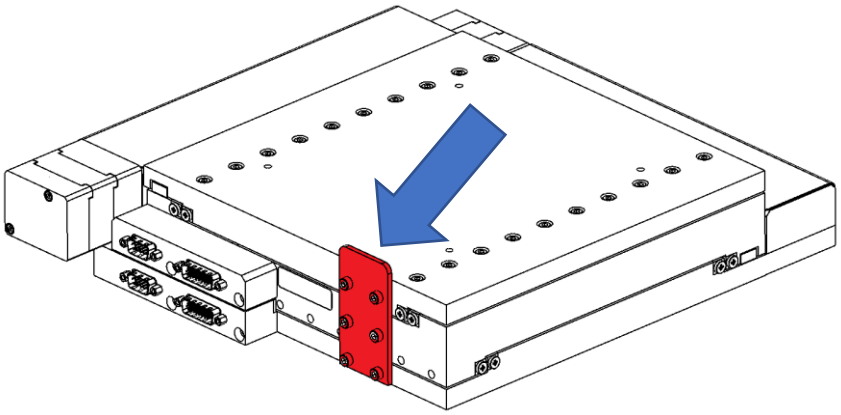


Figure 13. Removal of Shipping Lock

CAUTION: With the shipping lock now removed, the compound plate and loading plate can now move freely if unobstructed by a power-off brake. Be careful to not touch the scale and/or limit tapes on the bottom of these plates, as pictured in Figure 14. Failure to abide by this warning may cause damage to the stage.

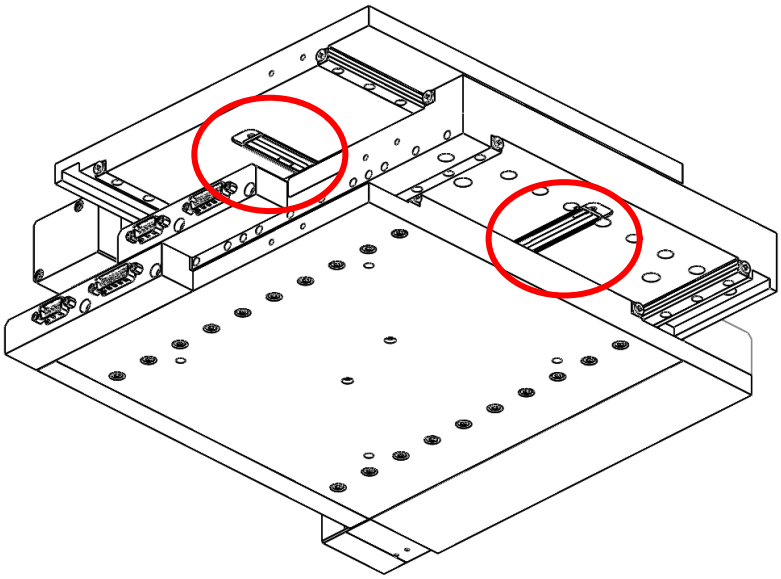


Figure 14. CXY Bottom View, Sensitive Scale Locations

4.1.4 BACKDRIVING THE STAGE

CAUTION: Never handle the stage when connected to a controller. This is to preclude accidental shock to the user, and to avoid potentially damaging the controller amplifier due to the BEMF generated by the motor (reverse power).

DANGER: When back driving, move the stage slowly and in a controlled manner. The BEMF generated by the motor may be higher than the permitted safety limits if the motor speed is sufficiently high. Connection of a temporary shunt network to the motor connector may be used to limit generated voltages.

Stages may be slowly back-driven, when not connected to controls, to allow access to better handholds and mounting holes without the need to power the stage (except where a power-off brake prevents an axis from moving). As discussed in previous sections, follow the precautions listed below when manipulating the stage by hand:

1. Never touch the stage under servo control, de-energize and disconnect first.
2. Never pick up the stage from the motor housings.
    a. Firmly grasp the stage from the compound plate or base plate.
3. You can defeat the power off break by applying 24V to the appropriate pins on the motor connector.
    a. Observe the appropriate electrical safety precautions.
    b. The only power source connected to the equipment shall be the 24Vdc supply.
    c. Ensure the protective earth connection is connected to the stage.
4. When back driving the stage, apply slow gradual pressure by hand.
5. Do not strike the stage or slam it into the hard stops.
6. Be careful to not contact the encoder or limit scale located on the bottom of the compound plate or loading plate.
7. Minimize contact and maintain cleanliness of mounting surfaces prior to installation.

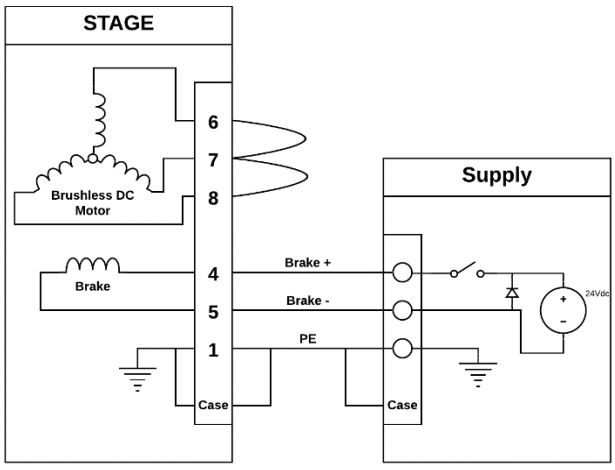


Figure 15. Example Brake override circuit

4.2 MOUNTING TO SURFACES

4.2.1 MOUNTING SURFACE REQUIREMENTS

Mounting surfaces for which a CXY stage is intended to be affixed must be stable, clean, flat, and adequately stiff to support the anticipated load. Any compromise to these mounting surface requirements will distort the baseplate of the device and decrease the overall accuracy. The CXY will generally conform to the shape of the mounted surface as shown in Figure 16.

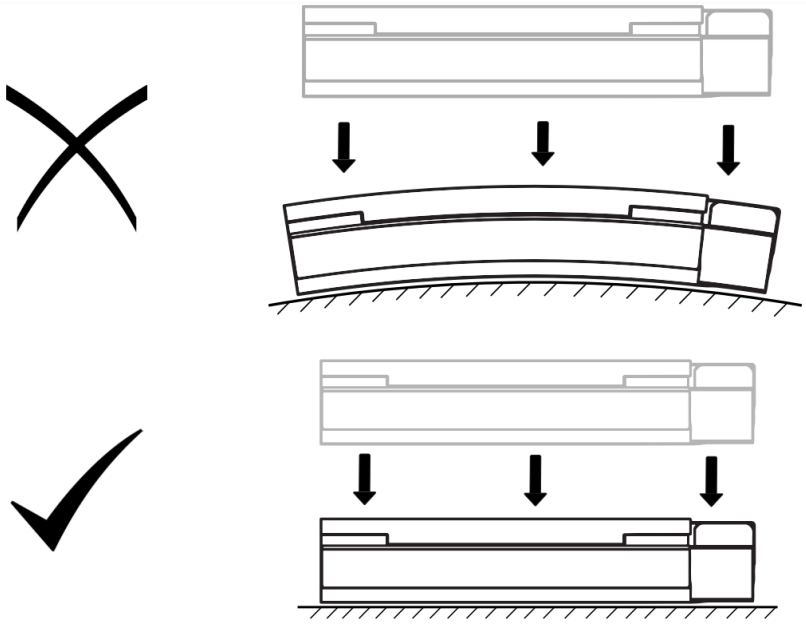


Figure 16. CXY warping to mounting surface contour

A surface flatness maximum recommendation is provided in Table 8. Note that a mounting flatness better than that listed will increase the accuracy performance of the machine.

Table 8. Mounting Surface Flatness Specifications

CXY Series	Specification
CXY-050	5um / 100mm
CXY-100	
CXY-150	
CXY-200	

4.2.2 GENERAL INSTALL

The procedure below assumes that the proper mounting surface has been prepared for use; taking into consideration the mounting hole pattern, mounting hole depth, flatness specification, cleanliness, surface stability, and means to override power-off brakes where applicable. Compatible M5 mounting hardware should be used.

1. Ensure that the stage is not connected to a controller or power is admitted to the motor.
2. Gain access to the first set of mounting holes for the respective product series below:
    a. **(For CXY-150 and CXY-200)** Gain access to the first set of mounting holes by back driving stage loading plate (topmost plate) in the negative direction.
    b. **(For CXY-050 and CXY-100)** Gain access to the first set of mounting holes by back driving the stage compound plate (middle plate) in the negative direction.

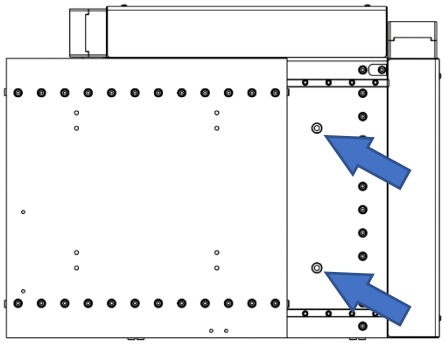


Figure 17. CXY-150 and CXY-200, First pair of mounting holes

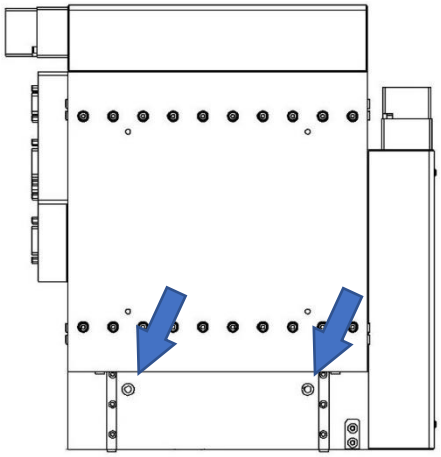


Figure 18. CXY-050 and CXY-100, First pair of mounting holes

3. It is recommended that the first set of M5 bolts are lightly tightened, and then back off by half a turn to facilitate centering of the second pair of bolts before final torque is applied.
4. Gain access to the second set of mounting holes for the respective product series below:
    a. **(For CXY-150 and CXY-200)** Gain access to the second set of mounting holes by back driving the stage loading plate (topmost plate) in the positive direction.
    b. **(For CXY-050 and CXY-100)** Gain access to the second set of mounting holes by first removing the ball screw cover for the top axis. After removal, the compound plate can be back driven in the positive direction to gain access to the second pair of mounting holes. Note, be careful to not contaminate the exposed ball screw while the ball screw cover is removed.

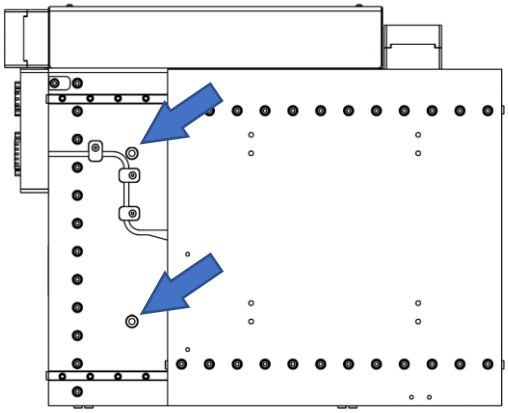


Figure 19. CXY-150 and CXY-200, Second pair of mounting holes

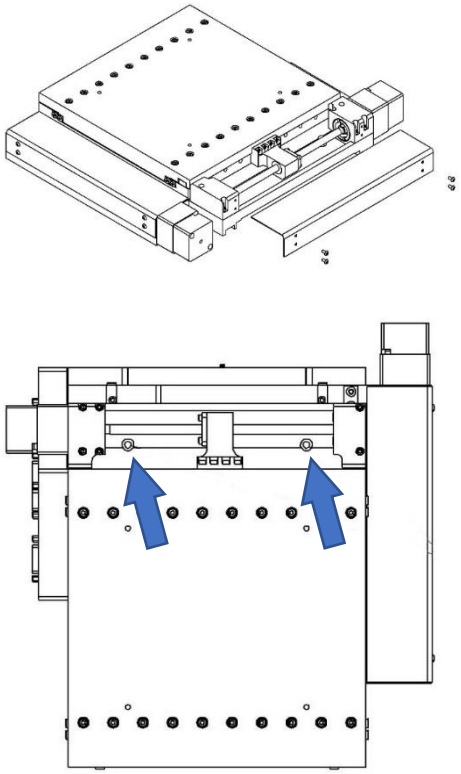


Figure 20. CXY-050 and CXY-100, Second pair of mounting holes through ball screw cover

5. Install the second pair of mounting hardware and center the stage about all four mounting screws that have been partially installed. Once in position, torque the second pair of M5 bolts to 45 in-lbs.
6. Slowly back drive the stage to access the first pair of mounting bolts, and torque that M5 hardware to 45 in-lbs.
7. Re-install the ball screw mounting covers, if removed.
8. Unless otherwise intended, check that the stage has full range of motion and will not contact any other surface or hardware.

4.3 MOUNTING OF PAYLOADS

4.3.1 PAYLOAD REQUIREMENTS

Payloads intended to be affixed to the CXY payload plate must be stable, clean, flat, and adequately stiff to support the anticipated load. Any compromise to mounting the payload properly will distort the payload plate of the CXY and decrease its overall accuracy.

A payload surface maximum flatness recommendation is provided in Table 9.

Table 9. Payload Flatness Specifications

CXY Series	Specification
CXY-050	5um / 100mm
CXY-100	
CXY-150	
CXY-200	

In addition, considerations for mounting orientation of the stage with respect to payload mass, payload position, and other forces should be made with respect to the stages listed specifications.

CAUTION: Ensure that retaining bolts for mounted payloads are the proper size and engagement depth. Improper installation may cause damage to the payload plate and reduce system performance or potentially render the stage inoperable.

5 ELECTRICAL INSTALLATION

5.1 CONNECTORS AND PINOUTS

The interface between a stage axis and a controller is provided through a D-sub 9 pin motor connector and a D-sub 26 high density feedback connector. Since there are two axes of control, there are a total of four connectors. The bottom pair of D-sub 9 and D-sub 26HD connectors control the bottom axis, and similarly, the top pair control the top axis.

Cabling with retainer screws are highly recommended, as the top pair of connectors will move with the stage as the bottom axis is positioned. Care should be taken to account for repetitive cable flexing and rubbing.

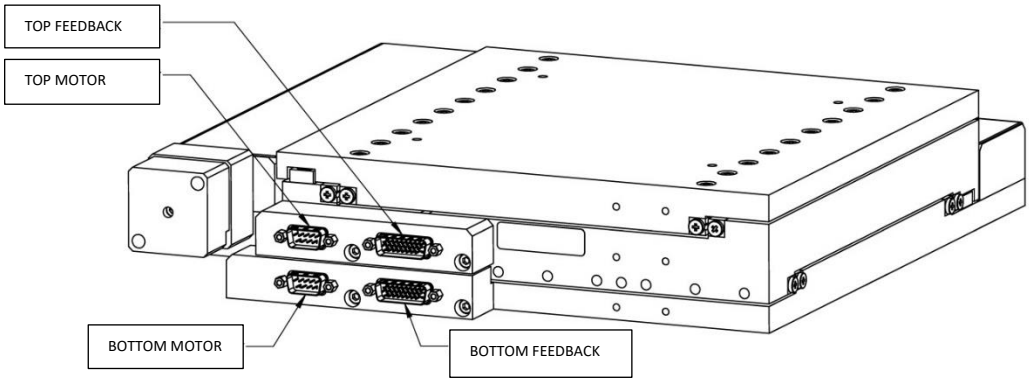


Figure 21. CXY Connectors View

5.1.1 MOTOR CONNECTOR

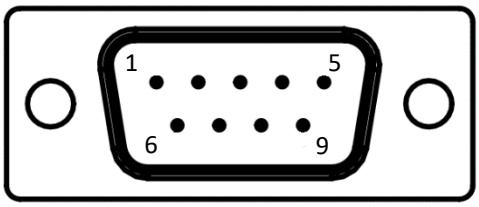
The motor connector provides power to two elements on the stage:

1. Brushless DC motor
2. Power-off brake (if equipped by additional option “D”)

Pin out for the male gendered motor connector, on the stage, is provided in Table 10.

Table 10. Motor Connector Pinout

PIN	DESCRIPTION
CASE	Protective Earth
1	Protective Earth
2	Reserved
3	Reserved
4	POWER-OFF BRAKE 24Vdc supply
5	POWER-OFF BRAKE 24Vdc return
6	Phase A
7	Phase B
8	Phase C
9	Reserved



Note: Do not connect any signal wire, power source, or ground to any pin labeled “Reserved”.

Example female gendered mating parts for motor connections is provided in Table 11.

Table 11. Mating Motor Connectors

Part Description	Manufacturer	Part Number
CONN D-SUB RCPT 9POS PNL MNT	Norcomp Inc.	171-009-203L001
CONN BACKSHELL SHLD	FCT Electronics	FMK1G

5.1.2 FEEDBACK CONNECTOR

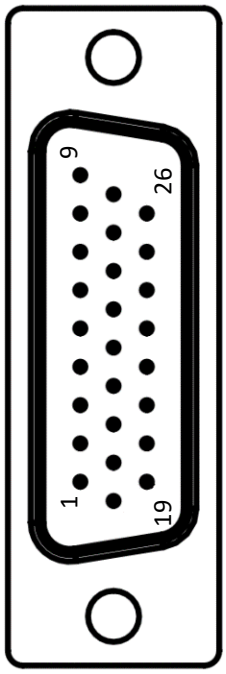
The feedback connector is the interface between all the primary feedback sensors of the stage to a controller. This includes signals such as:

1. Motor halls
2. Forward and reverse limits
3. Index and home signals
4. Encoder output (quadrature or sinusoidal)

Pin out for the male gendered feedback connector on the stage is provided in Table 12. Note that the linear encoder and rotary encoder ordering options are nearly identical, except for the addition of a home signal on the rotary encoder.

Table 12. Feedback Connector Pinout

PIN	DESCRIPTION		
	Rotary Enc.	**Linear Enc.**	**Linear Enc.**
	RS422	RS422	1Vpp
CASE	Protective Earth		
1	+5Vdc		
2	A+		Sin+
3	B+		Cos+
4	Z+		Idx+
5	LIM+		
6	Reserved		
7	Reserved		
8	Reserved		
9	Reserved		
10	Reserved		
11	A-		Sin-
12	B-		Cos-
13	Z-		Idx-
14	LIM-		
15	Reserved		
16	Reserved		
17	Reserved		
18	Reserved		
19	GND		
20	HALL A		
21	HALL B		
22	HALL C		
23	HOME	Reserved	
24	Reserved		
25	Reserved		
26	Reserved		



Note: Do not connect any signal wire, power source, or ground to any pin labeled “Reserved”.

Example female gendered mating parts for the feedback connections is provided in Table 13.

Table 13. Mating Feedback Connectors

Part Description	Manufacturer	Part Number
CONN D-SUB HD RCPT 26POS PNL MNT	Norcomp Inc.	180-026-203L001
CONN BACKSHELL SHLD	FCT Electronics	FMK2G

5.2 WIRING OVERVIEW

The diagrams found in this section elaborate on the basic interface requirements pictorially, which are representative of the previously specified characteristics as tabulated in Section 3.6. Example supporting circuit elements expected from the user's controller are also shown.

For details on the phasing relationships between motor BEMF, halls, and other feedback signals, refer to Section 5.4 of this user manual.

5.2.1 MOTOR ELECTRICAL DIAGRAM

The CXY brushless DC motor connections are shown in Figure 22; note that the brake is pictured, but is only available if the addition ordering option "D" is equipped.

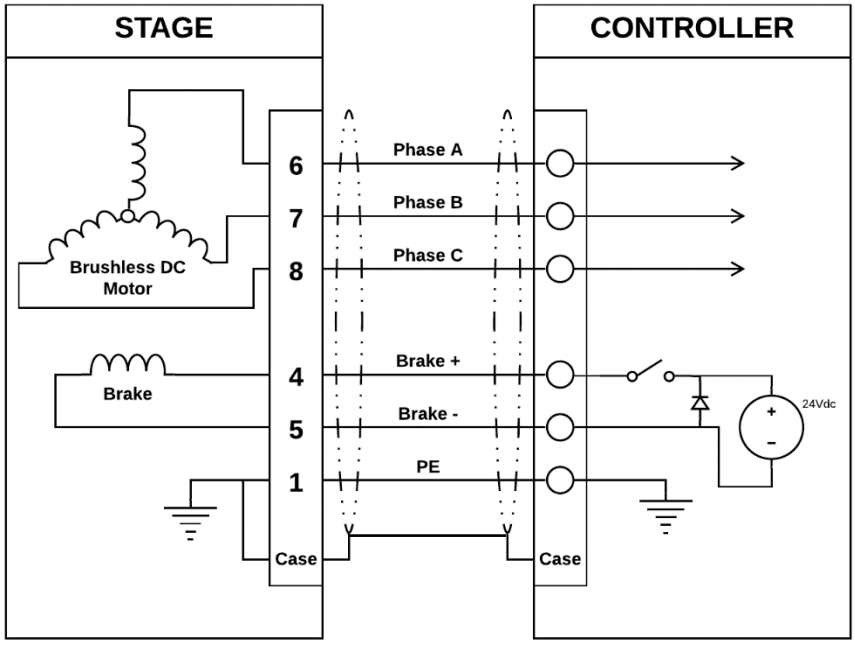


Figure 22. CXY Motor Connector Wiring Diagram

5.2.2 ROTARY ENCODER TYPE ELECTRICAL DIAGRAM

The CXY feedback connections for the variant using a rotary encoder, is shown in Figure 23.

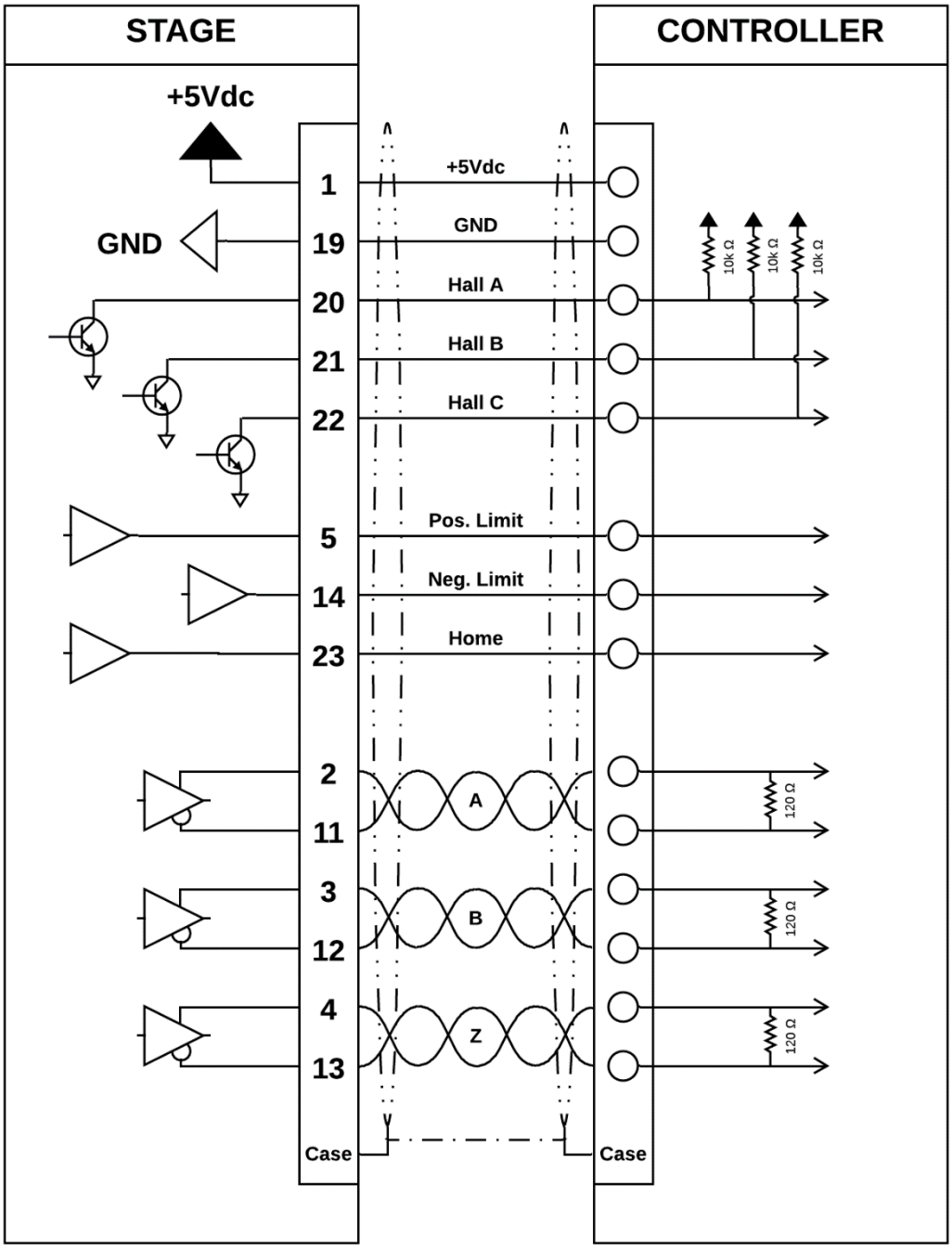


Figure 23. Rotary Encoder Electrical Diagram

5.2.3 LINEAR ENCODER TYPE ELECTRICAL DIAGRAM

The CXY feedback connections for the variant using a linear encoder setup, is shown in Figure 24.

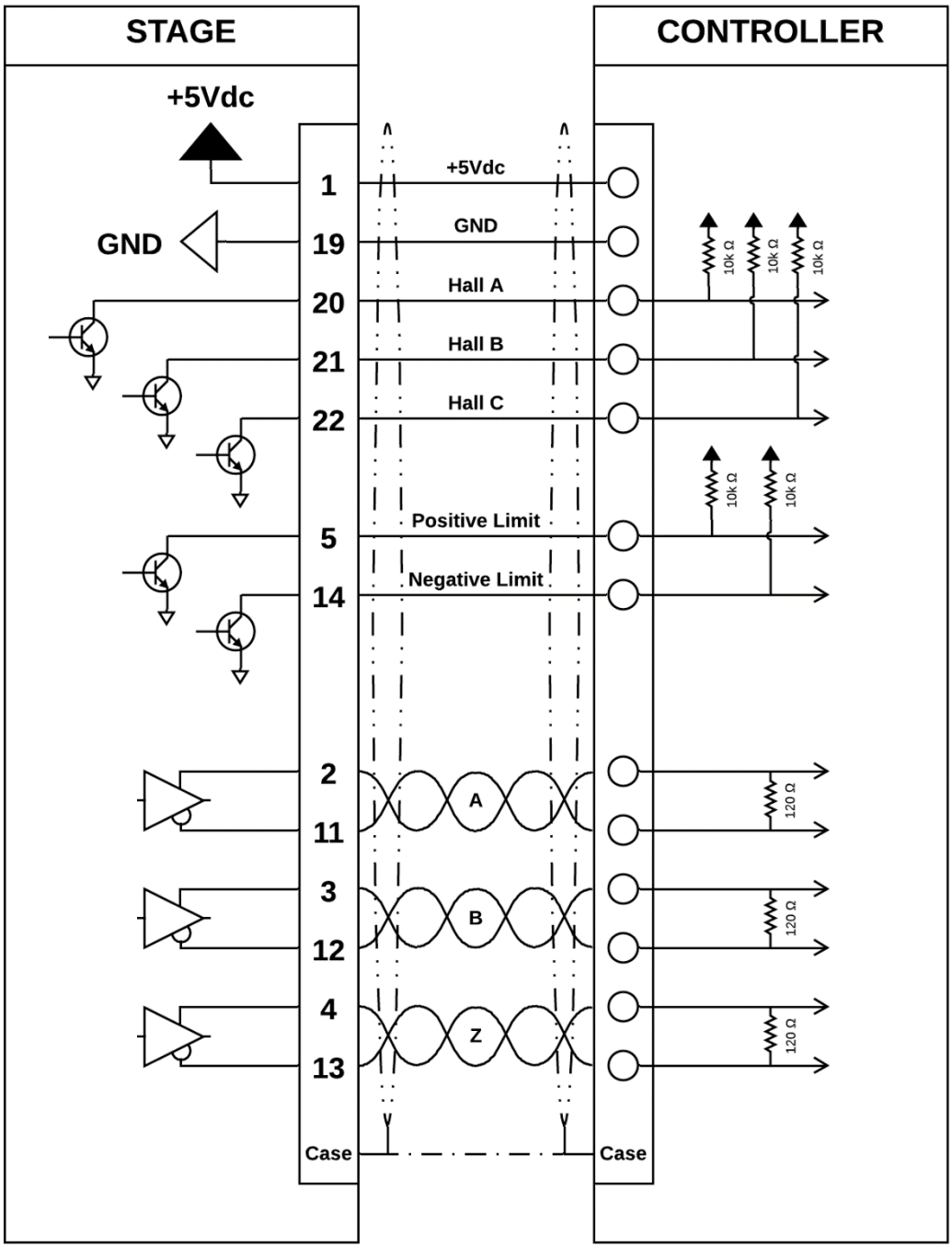


Figure 24. Linear Encoder Wiring Diagram

5.3 SHIELDING AND GROUNDING

As shown in Figure 25, the protective earth ground pin on the motor connector and shielding connection points are shown. These are the primary connections provided to the user to interface with.

For proper operation, the user must connect the shielding and protective earth grounding points as shown in the example electrical wiring diagrams of Section 5.2. This will ensure safety to the user, and high reliability of the motor and feedback systems of the stage to achieve optimal performance.

CAUTION: The user should not attempt to use any bolt hole not labeled “PE” if additional grounding is desired. Improperly using bolt holes on the CXY chassis may provide an unreliable safety ground point and may cause damage to the alignment of rails or precision surfaces.

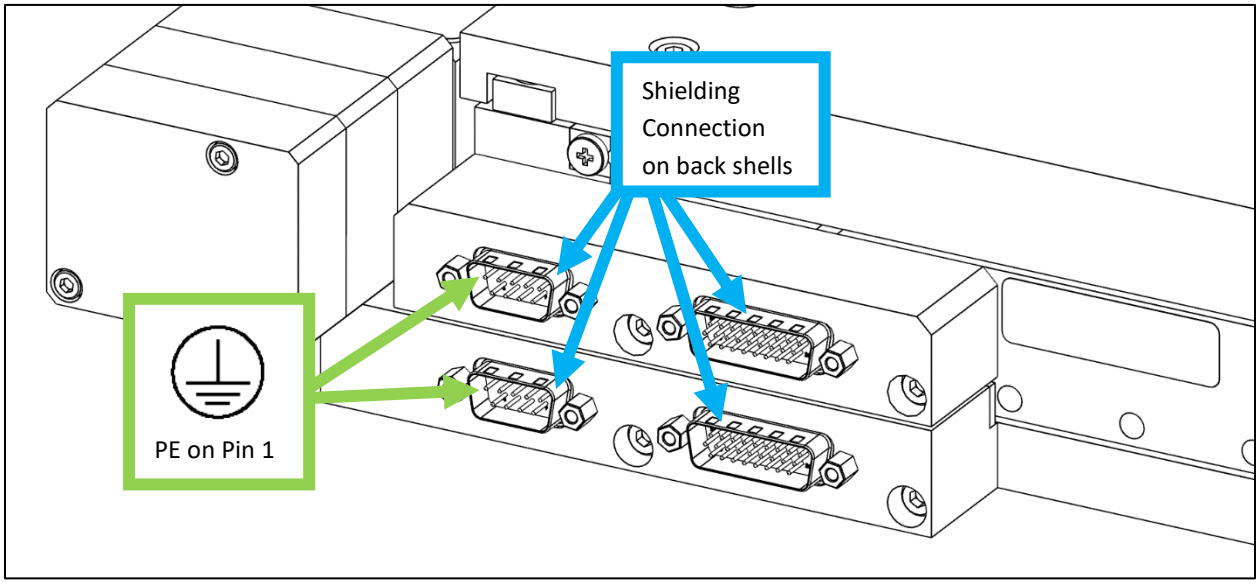


Figure 25. CXY Protective Grounding and Shielding Locations

5.4 MACHINE DIRECTION AND PHASING

5.4.1 MACHINE DIRECTION

The machine direction is the mechanical traversal of an axis in a specified direction, such that the associated electrical signals are phased and aligned in a defined and repeatable manner. Advanced controllers have the capability of easily reading and redefining the machine direction to a user's needs, however, for those controllers which do not have this capability, Section 5.4 elaborates on the expected electrical signal sequences that the hardware is expected to produce.

For conciseness, all phasing diagrams in this section will represent forward direction traversal of an axis on the stage from the left to the right-hand side of each graphic.

The positive machine direction for either axis of the CXY is away from the motor housing, as shown in red in Figure 26; conversely, negative direction of the axis is toward the motor housing as shown in blue.

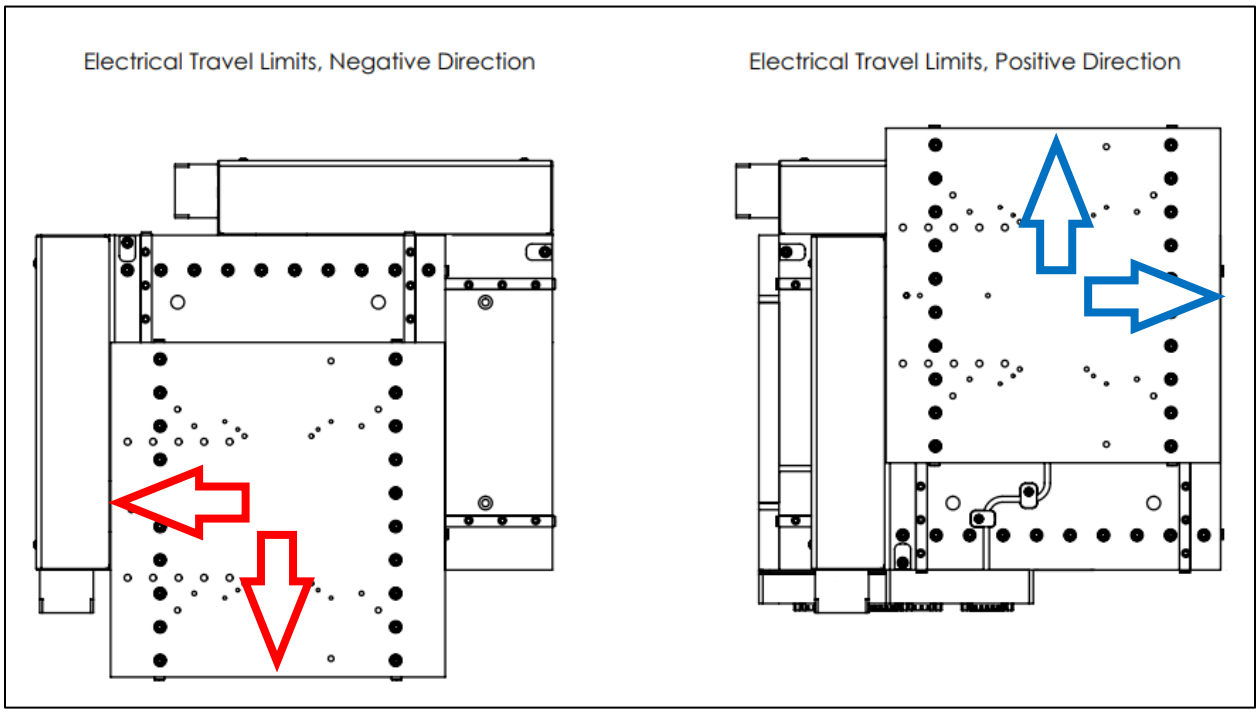


Figure 26. CXY Travel Directions, Top view

5.4.2 MOTOR, ENCODER, AND HALL PHASING

Figure 27 details the Motor BEMF with respect to the Hall outputs in the sequence that would be observed in the forward direction from left to right. BEMF waveforms are referenced to the respective phases as indicated, and the Hall signal levels are shown as pulled up by an external resistor and referenced to ground.

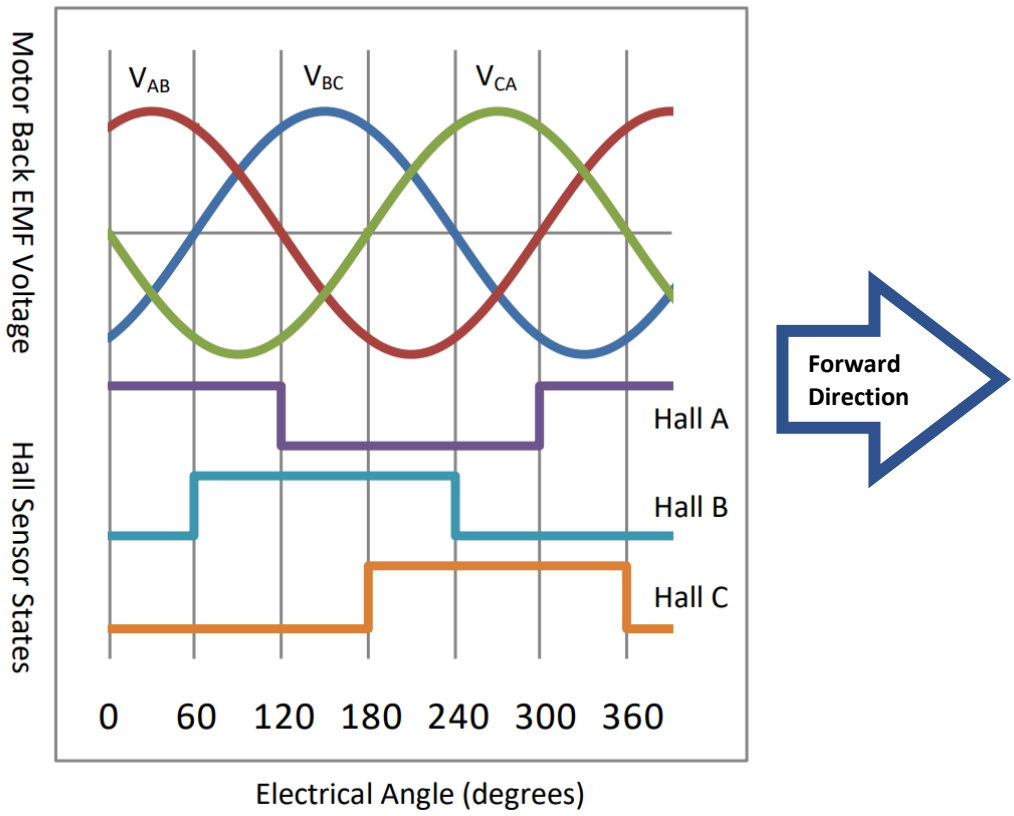


Figure 27. Motor and Hall Output in Forward Direction (left to right)

Figure 28 details the quadrature phasing as the stage travels in the forward direction. Waveforms are measured from the Positive Signal (A+ or B+) with respect to the negative counterpart (A- or B- respectively).

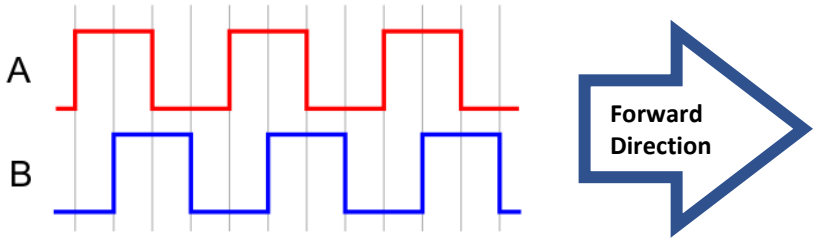


Figure 28. Quadrature Output in Forward Direction (left to right)

5.4.3 ROTARY ENCODER MARKERS

A home switch is provided near center mechanical travel and a limit switch at each end of travel. The encoder will output one index pulse per revolution of the motor; therefore, the index pulse is a function of the ball screw pitch. This pulse is highly repeatable and can be used in coordination with the home switch to find an absolute position after power-up.

The limit and home switches are open collector devices, which will be pulled down to a low impedance state throughout the travel range of the stage, and open to a high impedance state when triggered at their respective ends of travel.

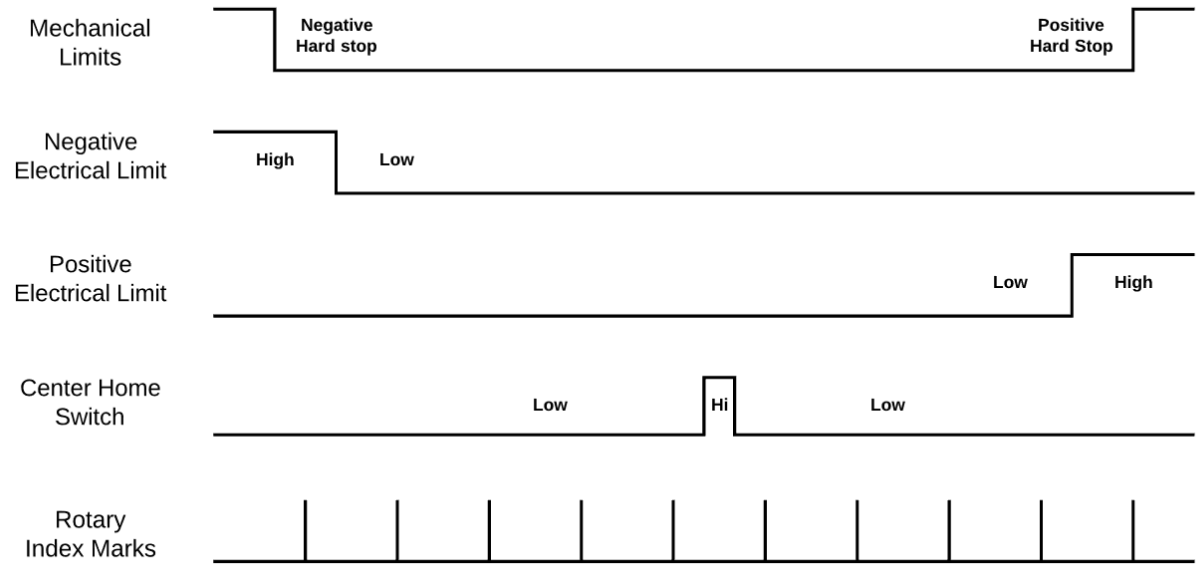


Figure 29. Diagram of Rotary Encoder Markers

5.4.4 LINEAR ENCODER MARKERS

The encoder will output one index pulse near center travel. This pulse is highly repeatable and can be used to find an absolute position after power-up.

The limit switches are open collector devices, which will be pulled down to a low impedance state throughout the travel range of the stage, and open to a high impedance state when triggered at their respective ends of travel.

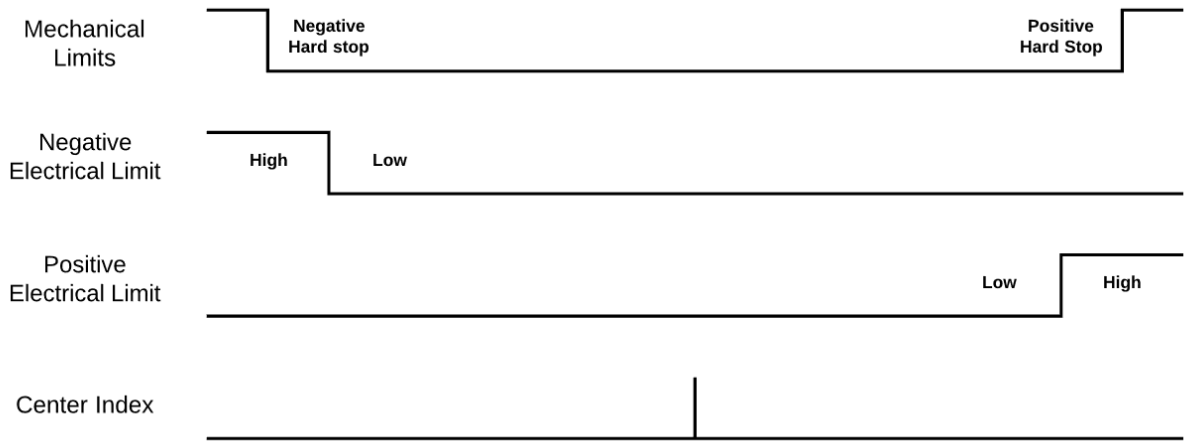


Figure 30. Diagram of Linear Encoder Markers

5.5 CABLE CONSTRUCTION CONSIDERATIONS

In assisting the integrator, a couple design considerations are discussed below which will help prevent common system failures and help increase reliability concerning cable construction and use in a control system.

Twisted Pairs – encoder signals (A, B, Z) are provided as differential outputs. It is highly recommended that these signals are connected to the controller from the stage using twisted pair wires to increase noise immunity and terminated at an appropriate differential input channel on the controller.

Shielding – shield the feedback cable and motor cable to prevent induced susceptibility and radiated emissions problems. Connect ground and PE connection points from the stage to controller for maximum safety and EMC considerations.

Protection – note that the top axis motor and feedback connectors are attached to the compound plate which moves during operation of the bottom axis. Care should be taken to account for possible cable rubbing, chafing, flexing, and pinching during operation.

Retainers – Connectors with retaining screws are highly recommended to prevent incidental disconnection during operation.

5.6 CONTROL SYSTEM CONSIDERATIONS

There is a myriad of suitable controllers on the market today which have the capability of driving the Griffin Motion CXY stage. Listed below are a few recommended fault and limit functions which should be implemented to maintain safe and efficient operation of the stage:

Verification and Tuning – It is highly recommended that the installer firstly verifies operation of the stage with a controller of their choice, with no payload attached in the lying flat orientation. After which dummy payloads simulating their device can be used to tune the system and verify requirements prior to installing sensitive equipment.

Velocity Limit – set in a manner as to not exceed machine mechanical limits and electrical limits; for example, set velocity limit to prevent overrun of the quadrature output of the encoder or the capability of the controller to read the quadrature input.

Position Error Limit – prevent runaway conditions should a cable, feedback mechanism, or current control fail to operate as desired.

Continuous and Peak Current Limits – the controller is responsible for implementing safe current regulation. Simple peak and continuous current limitations may not be sufficient, whereas protection algorithms such as I2T should be implemented.

Electrical and Software End-of-Travel Limits – operation should never occur beyond the electrical limits; additionally, the user application at certain velocities may require a smaller operating envelope so that a controller may have sufficient time and distance to decelerate the stage before hitting a hard stop; consider implementing software limits where applicable.

6 MAINTENANCE

6.1 INSPECTION

Depending on the cleanliness of your operating environment or system process, the general inspection interval may need to increase. For normal laboratory use, not involving the creation of debris, the following minimum inspection interval and criteria are suggested.

Inspection Interval: Monthly
Inspection Criteria:

- Check Cables for:
  - Visually inspect cables for fraying.
  - Check cables for loose connections.
  - Replace damaged cables.
  - Check resistance of protective earth bonding to controller.
- Check cleanliness for:
  - Excessive debris on ball screw.
  - Debris in between base plate and compound plate.
  - Debris in between the compound plate and the loading plate.
  - Debris in linear bearings.
  - If excessive debris is found, follow the guidance in the lubrication section.

6.2 CLEANING AND LUBRICATION

Cleaning of large accessible surfaces can be achieved by use of a lint free cloth dampened with denatured ethanol.

Avoid getting cleaning agents or water into the ball screw or precision rails, as this will breakdown the lubricants, embed contaminants into seals and crevices, and ultimately affect machine life.

Cleaning and lubrication of components such as the precision rails and ball screw require disassembly beyond the scope of this document and is not recommended to be attempted by a technician without proper training.

Lubricants used in the assembly of Griffin Motion CXY stages are intended to last the useable life of the device, given that the cleanliness of the environment is maintained consistent with the expected use and the duty cycle is moderate with respect to the listed specifications.

For applications in which the CXY is used at high duty cycles, or for OEM applications, please contact a Griffin Motion Representative.

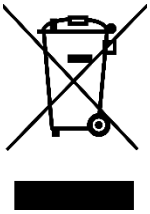
6.3 TROUBLESHOOTING

Some troubleshooting guidance is listed below in Table 14.

Table 14. Troubleshooting CXY issues

Problem	Root Cause and/or Propose Solution
One or both axes will not move (unpowered)	• Check that shipping lock is removed. • Axis may contain a power-off brake. Verify part number and documentation. Defeat with jumper or controls.
One or both axes will not move (powered)	• Verify motor pinout from controller to stage. • Hall phase order may be incorrect. • Hall sensor may not be detected, check schematic implementation. • Motor failure, check pin-to-pin resistance to verify. • Controller requirements to servo may not be met, check manual.
Stage Runaway or erratic behavior	• Encoder feedback wrong direction • Encoder not connected or failed. • Improper current or servo tune loop gains. • Improper shielding of feedback cable causing erroneous encoder or hall effect sensor signals.
Missing or additional feedback counts	• Improper shielding of feedback cable or motor cable. • Loose connection on feedback cable. • Machine velocity too high, missing counts. • Encoder not connected or failed.
Stage power lower than expected	• Check current gains and monitor current admitted to motor. • Motor current phase angle offset is incorrect.
Excessive Vibration	• Servo or current tune loop gains need adjustment. • System setup has a resonant frequency that must be damped.
High Torque required during normal operation	• Ball screw mis-aligned, call Griffin Motion for assistance. • Contamination in ball screw or precision rails. • (if equipped) power-off brake has not been disengaged.
Stage cannot get to electrical limit	• Stage obstructed, check pinch points. • Electrical limit or cabling has failed.
Intermittent failure or operation	• Loose cable connections to stage or controls • Amplifier VBUS unstable or too low • Encoder read head damaged • Motor hall effect sensors damaged. • Motor winding damaged.
Motor noise during operation	• Current loop gains set too high • Contamination in ball screw or precision rails • Rubbing noise from power-off brake.

6.4 SCRAPPING AND DISPOSAL



The CXY Stage is electrical and electronic equipment that should be disposed of in a proper manner. Dispose of old equipment in accordance with the appropriate international, national, and local rules and regulations.

If you need assistance in proper disposal, or you would like to send the machine back to Griffin Motion for disposal, please reach out to a representative for RMA information.

7 SERVICE AND SUPPORT

7.1 SERVICE

If you need any assistance regarding product integration, application, identification, inspection, repairs, or new business opportunities, please contact a Griffin Motion Representative so that we may better assist you. Contact information is displayed at the beginning of this document.

7.2 GENERAL WARRANTY

Griffin Motion, LLC [hereafter GM] warrants that, for a period of one year from the date a [machine] is delivered to the Buyer, such [machine] will be free from material defects in workmanship and materials provided by GM. Buyer's sole and exclusive remedy for a breach of this warranty will be, at GM's option, either (i) credit in the amount of the purchase price of the defective [machine], or (ii) repair or replacement, at GM's expense, of the defective [machine] within [twenty (20)] days after receipt by GM of written notice of the defect from Buyer. Costs in connection with GM's repair or replacement of any defective [machine], including, parts, labor, cost of standard return transport from GM to buyer, will be borne by GM. If available, GM will provide Buyer a temporary loaner [machine] while repairs are made to any defective [machine]. This warranty will continue as to the repaired or replaced [machines] for the remainder of the original 1-year warranty period. This warranty will not apply to defects arising from neglect, accidental damage, repair, or maintenance not performed by GM, or use of the [machine] for any purpose other than the purpose for which it was designed. GM DISCLAIMS ANY AND ALL OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED, WITH RESPECT TO THE [MACHINES]. GM WILL HAVE NO LIABILITY FOR CONSEQUENTIAL, INDIRECT, SPECIAL, INCIDENTAL, EXEMPLARY, OR SIMILAR DAMAGES ARISING OUT OF OR RELATING TO THE [MACHINE] OR THE USE THEREOF BY BUYER, INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF PROFITS, BUSINESS INTERRUPTION, OR OTHER PECUNIARY LOSS, EVEN IF GM HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.