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User Guide

Micropositioners

MS Series

PN 108-206, Revision F, August 13, 2018

FormFactor™

User Guide

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PN 108-206, Revision F, August 13, 2018

FormFactor™

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Before You Begin

About This Guide

Welcome to the *MS Series Micropositioners User Guide*. This guide contains information about micropositioner mounts and planarization.

Notational Conventions

This manual uses the following conventions:



NOTE

Note is used to indicate important information about the product that is not hazard related.



CAUTION

Caution is used to indicate the presence of a hazard which will or can cause minor personal injury or property damage if the warning is ignored.



WARNING

Warning is used to indicate the presence of a hazard which can cause substantial personal injury or property damage if the warning is ignored.



DANGER

Danger is used to indicate the presence of a hazard which will cause severe personal injury, death or substantial property damage if the warning is ignored.

For More Information

More information may be available from these sources:

- Your probe station user guide
- Release Notes
- FormFactor's website at www.formfactor.com.
- If you purchased your FormFactor product from a third-party vendor, you can contact that vendor for service and support.

Chapter

1 Overview

Micropositioner Overview

Features

- Three axes of linear motion are available, with either 25.4 mm or 50.8 mm (1-inch or 2-inches) of travel.
- High-resolution, true linear motion provides ultra precise probe-tip placement (0.1 micron step size).
- Small positioner size allows up to (6) micropositioners to be fitted to a 203 mm (8-inch) station.
- Positioners can be operated manually, or through the use of the ERJ-02 joystick or the probe system software.
- Both right- and left-handed models are available.
- Positioners are D.C.-, active-, coaxial-, or triaxial-probe compatible for capturing low level and high frequency measurements.
- Mounts for most probes, grippers, and cutters are available.
- An an IEEE interface is also available.

Requirements

MS-Series micropositioners require the following:

- An ECX-56 expansion box (or equivalent)
- An ECA-53 expansion drive card (one card is required by each micropositioner)

Safety

The information in this guide facilitates the safe and effective operation of equipment. Any deviation from the recommended procedures, modification to or use of the equipment for a purpose for which it is not designed may create a hazardous operating situation. FormFactor, Inc., disclaims any responsibility for consequences resulting from any such deviation, modification, or application.

Returning a Micropositioner for Service

RMA Number

Before shipping a probe station to FormFactor, obtain a Return Material Authorization number (RMA #). Contact the nearest FormFactor sales office, or in the U.S. call customer service at (800) 550-3279 or (503) 601-1000.

Write the following information on a tag and attach it to the probe station:

- Owner's name and address
- RMA number
- Probe station model number
- Probe station serial number (back left of probe station)
- Description of the service required or failure indications

Repacking

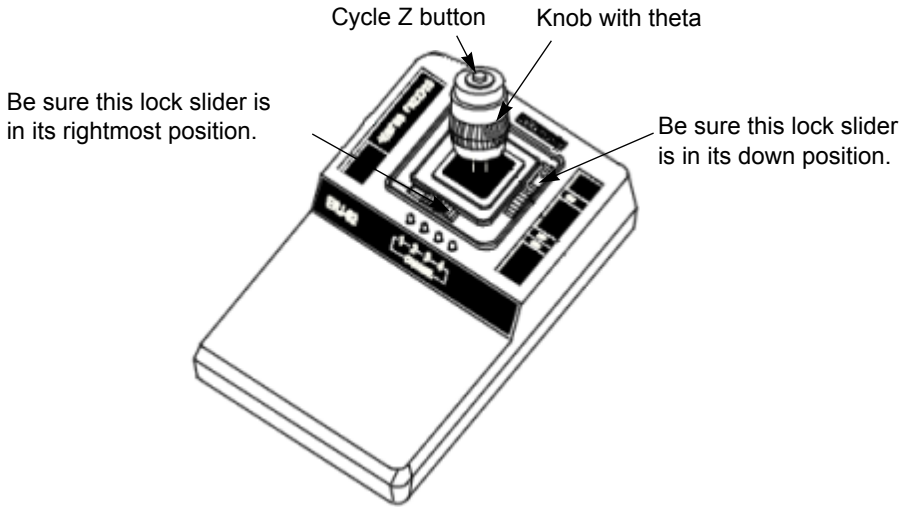
To retain the validity of the warranty, always use the original packing materials. Contact a FormFactor representative for replacement shipping materials or hardware.

Chapter

2 ERJ-02 Joystick

Controls

The ERJ-02 controls up to four channels in x, y and z (plus theta, if DUT is used).



CAUTION

Be sure that the locking sliders are in the positions shown above. If positioned incorrectly, the z-knob will fall to one side, causing the stage to drift. This movement can cause the probes to crash.

Knob with Theta	The knob is used for x-, y-, z-, and theta-motion.
Channel Select Button	The channel select button is used to change the channel that the knob controls. The channel LED indicators indicate the channel that is currently active.
Channel LED Indicators	The channel LED indicators indicate the channel that is controlled by the knob.
Set Button	The set button is used in conjunction with other buttons for “setting” certain parameters of stage motion.
Locking Sliders	The locking sliders must remain in the locked position. If positioned incorrectly, the z-knob will fall to one side, causing the stage to drift. This movement can cause the probes to crash.
Cycle Z Button	This button selects the axis that is controlled by the knob.
Con and Sep	The Con(tact) and Sep(arate) buttons are used for moving the chuck to the contact and the separate positions.
Channel indicators	Four channel LED indicators indicate the currently active channel. Pressing the Channel Select button will cause the channel to change. If the channel indicator blinks, the theta stage is active. Twisting the knob will cause the DUT to rotate.
Channel selector LED	If the channel selector button blinks, the z-axis is active. Twisting the knob will cause the channel to move in z.

Con and Sep LED	If the Con LED indicator is turned on, the z-axis is at the contact position. If the Sep LED indicator is turned on, the z-axis is at or beyond the separate position. If neither of the Con or Sep LED indicators are on, it means the z-axis is somewhere in between the contact and separate positions. If the Con or Sep LED indicators are blinking quickly, at least one channel has not yet been initialized.
Set LED	If the Set LED indicator is blinking, the set mode is active. The next button pressed while in set mode will have an effect on the motion parameters for the joystick. For example, pressing the Con button will load the current z-position as the contact position. Pressing the Sep button will load the current z-position as the separate position.

Operation

Initializing Channels

Initializing a channel causes the prober to find the center of travel for that channel. The center then becomes the home position.

CAUTION

Before initializing a channel, ensure that the probes and wafer will not crash.

If either the Con or the Sep buttons are blinking quickly, at least one channel has not been initialized.

Clear the fast blinking before using the probing station.

1. Press the channel select key until the channel to be initialized is active (Channel LED is on).
2. Press and hold the set key, then press the channel select button. The channel will begin initializing. Release both buttons.

NOTE

To interrupt the initialization process, simply move the joystick. Doing so leaves the channel in an uninitialized state.

3. When the initialization is finished, all four channel LED indicators will blink for about 1/4 of a second.

Activating a Channel

After all channels have been initialized, the channel select button can be used to change the channel currently controlled by the knob. The following table shows the LED indicating each channel.

LED	Channel
1	DUT, or Scope, or Probe 1
2	Scope
3	Probe1
4	Probe2

NOTE

If either the channel select LED or the channel LED is blinking, the knob is in z- or theta-mode. Pressing the channel select button will have no effect. Press the Cycle (z) button until no LED indicators are blinking. Then press the channel select button to change the channel.

Selecting Axis (X, Y, Z, Theta)

After a channel has been selected, the Cycle (z) button on top of the knob can be used to select the axis currently controlled by the knob.

- When a channel is first selected and no LED indicators are blinking, the knob controls the x/y axis. Moving the knob will cause the x/y stage to move. The more the knob is deflected, the faster the stage will move.
- Pressing the Cycle (z) button once will cause the channel select LED indicator to blink. This means that the knob controls z-axis. Twisting the knob causes the z-axis to move. The more the knob is twisted, the faster the stage will move. Pushing the knob in x or y will have no effect.

NOTE

The z-axis has protections built in so it will not move beyond the contact position. If the z-axis reaches the contact position, it will stop moving and the channel LED indicators will blink simultaneously. This is to protect the probes and wafer from being damaged. Releasing the knob will make the channel LED indicators stop blinking. To move the z-axis beyond the contact position, the Set mode must be activated.

- If the current channel is the DUT, pressing the Cycle (z) button again will cause the Channel LED to blink. This means the knob controls theta rotation. Twisting the knob causes the theta stage to rotate. Pushing the knob is x or y will also cause the x/y stage to move.
- Pressing the Cycle (z) button again will set the mode back to x/y (no LED indicators blinking).

Set Contact Location

The contact location is the stored z-position for a channel that is moved to make the probes contact the wafer. Set the contact position for the DUT before the probes.

1. Press the channel select key to select the channel to be set.
2. Press the Cycle (z) button to activate the z-axis. The channel select button will begin blinking.
3. Press the Set key. The set key will begin blinking, indicating the set mode is active.
4. At this point, the normal protections for the z-axis are disabled (i.e., the z-axis will be allowed to move its full range of motion).
5. Twist the knob to move the z-axis to the desired contact position.
6. Press the Con button to store the current z-position as the contact position and deactivate the set mode.
7. Press the Sep button. The z-axis will move to the separate position.
8. Press the Con button to return the z-axis to the contact position that was just loaded.

CAUTION

To avoid the risk of severe damage to the wafer and probes, set the DUT contact before using the probes.

Set Separate Location

The separate location is the stored z-position for a channel that is to be moved to take the probes out of contact with the wafer. The z-axis will move to the separate position before any x/y or theta moves occur.

The default separate position (100 microns above contact) is adequate for most applications. The separate position is relative to the contact position, so loading a new contact position will change the separate position as well (it's usually not necessary to set the separate position).

1. Press the channel select key to select the channel to be set.
2. Press the Cycle (z) button to activate the z-axis. The channel select button will begin blinking.
3. Twist the knob to move the z-axis to the desired separate position. The separate position must always be further away from the wafer than the contact position.
4. Press the Set button. The set button will begin blinking, indicating the set mode is active. Note while the set mode is active, the protections for driving the z-axis into the wafer are temporarily disabled.
5. Press the Sep button to store the current z-position as the separate position and deactivate the set mode.
6. Press the Con button. The z-axis will move the contact position.
7. Press the Sep button to return the z-axis to the separate position that was just loaded.

Set Increment Distance

Increment moves are used to move a whole die location. Setting the increment involves loading the same corner on two adjacent die so that the prober can calculate the distance between rows and columns.

1. Select the DUT or Scope channel.
2. Move to a corner of a die.
3. Press the Set key to activate the set mode. The set button will blink.
4. Press the Cycle (z) button (top of knob) to save the current position in x and y. The set button will blink faster.
5. Move to the same corner of the next die. Move a row and column (kitty-corner).
6. Press the Cycle (z) button again. The distance between the two corners is computed and stored. The Set button will stop blinking.

Move in Increments (Die Stepping)

Die stepping is used to move the stage one complete row or column. This requires the die size to be loaded first.

1. Press and hold the Set button.
2. Deflect the knob. The amount of deflection does not matter as the stage will move either one row or one column.

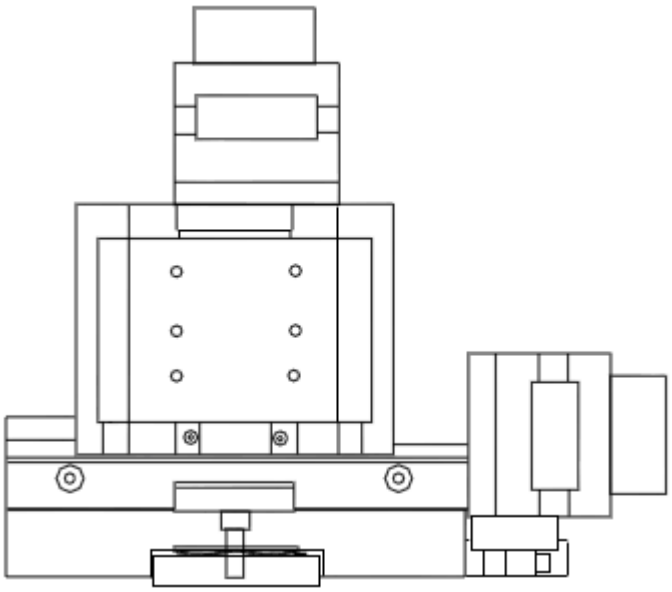
Chapter

3 MAC-Series Mounts

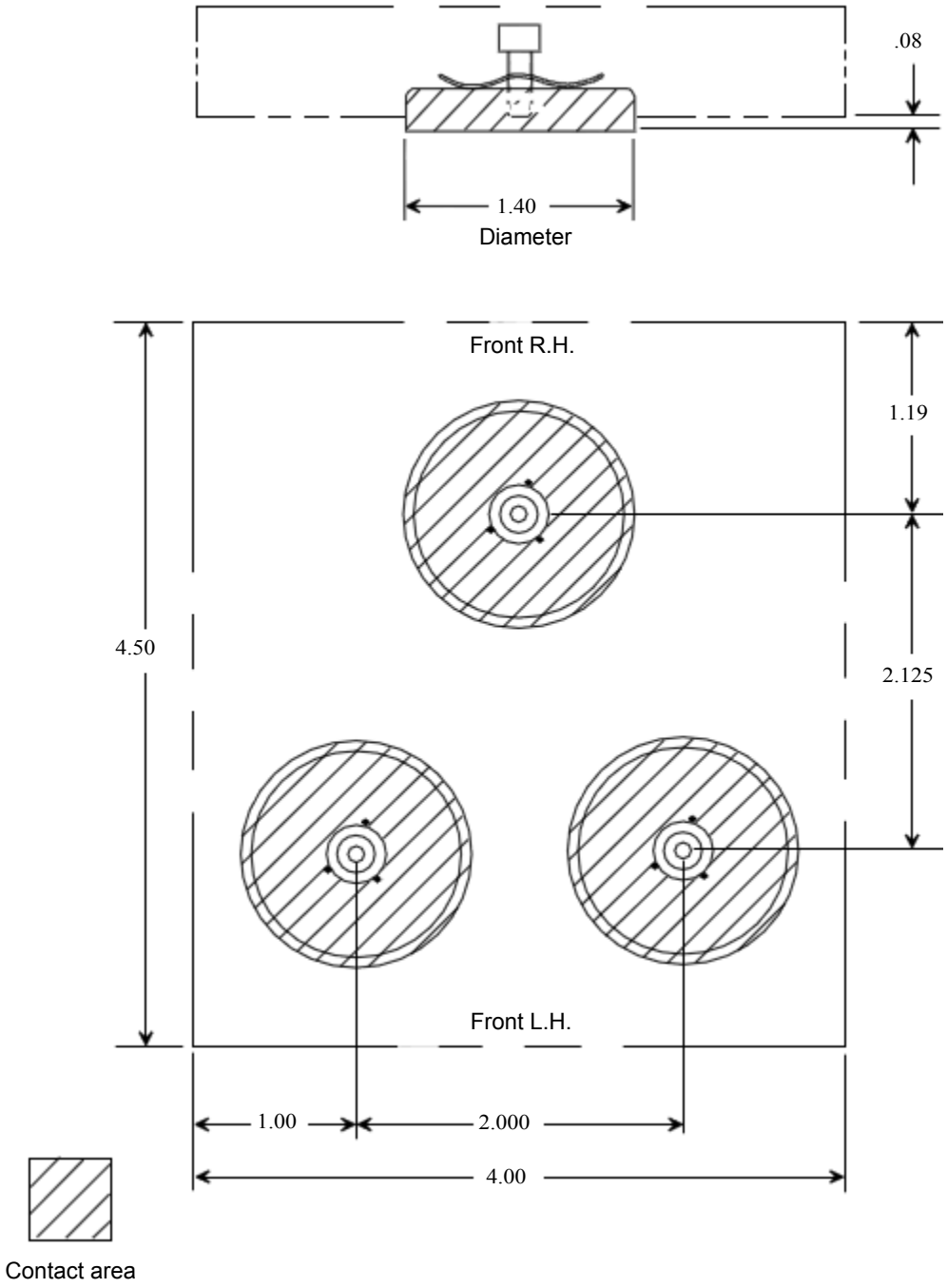
MAC-02 Magnetic-Mount

NOTE

Magnetic-mount positioners are not recommended for microwave testing.



MAC-02 Mount Dimensions

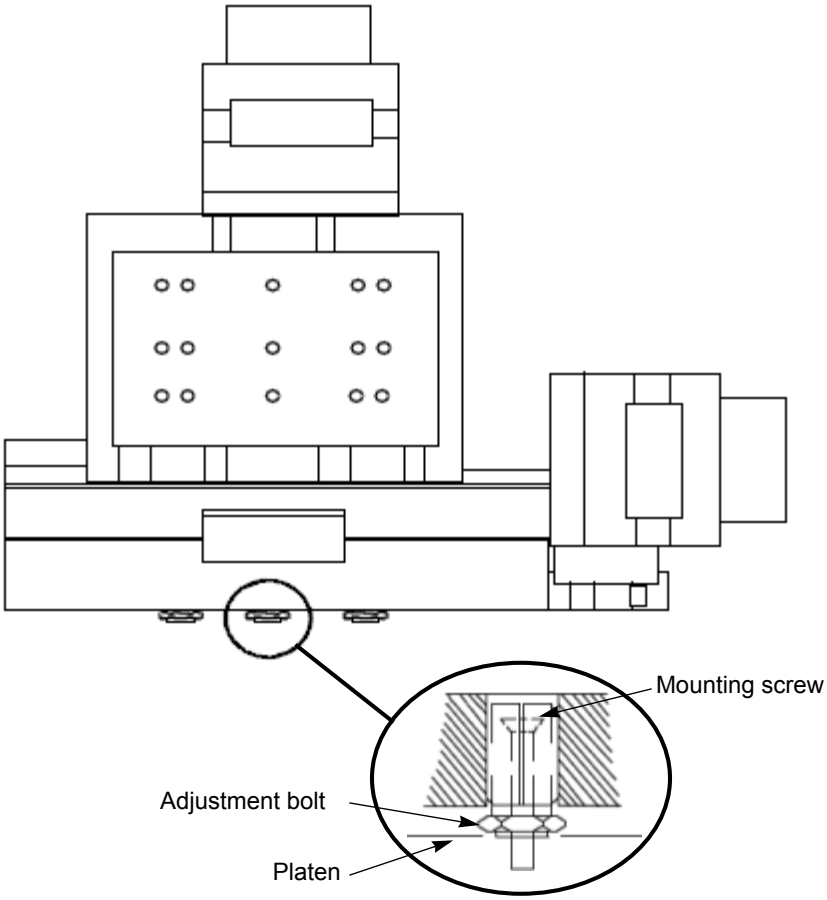


MAC-05 Bolt-Down Mount

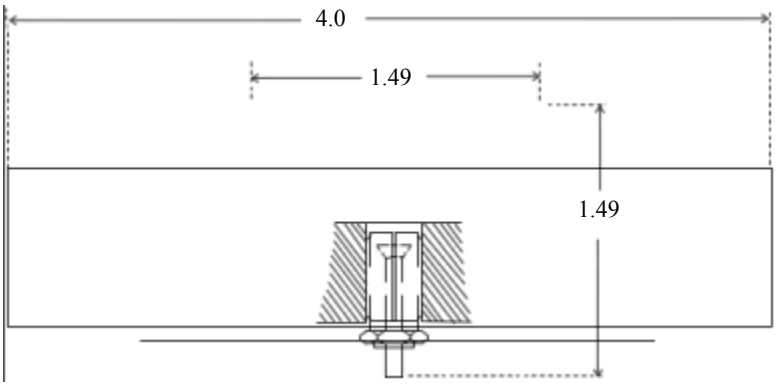
CAUTION

Make sure that the mounting screws are tight.

Three (3) 6-32 x .88-inch mounting screws are used to fasten the MAC-05 mount to the micropositioner. Three (3) adjustment bolts hold the mounting screws and are used for fine planarization adjustments.

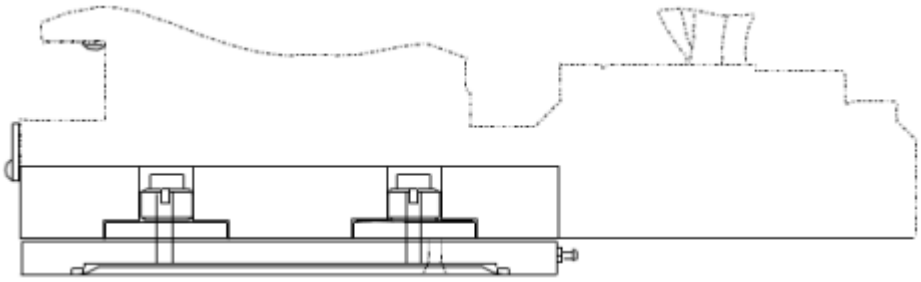


MAC-05 Mount Dimensions

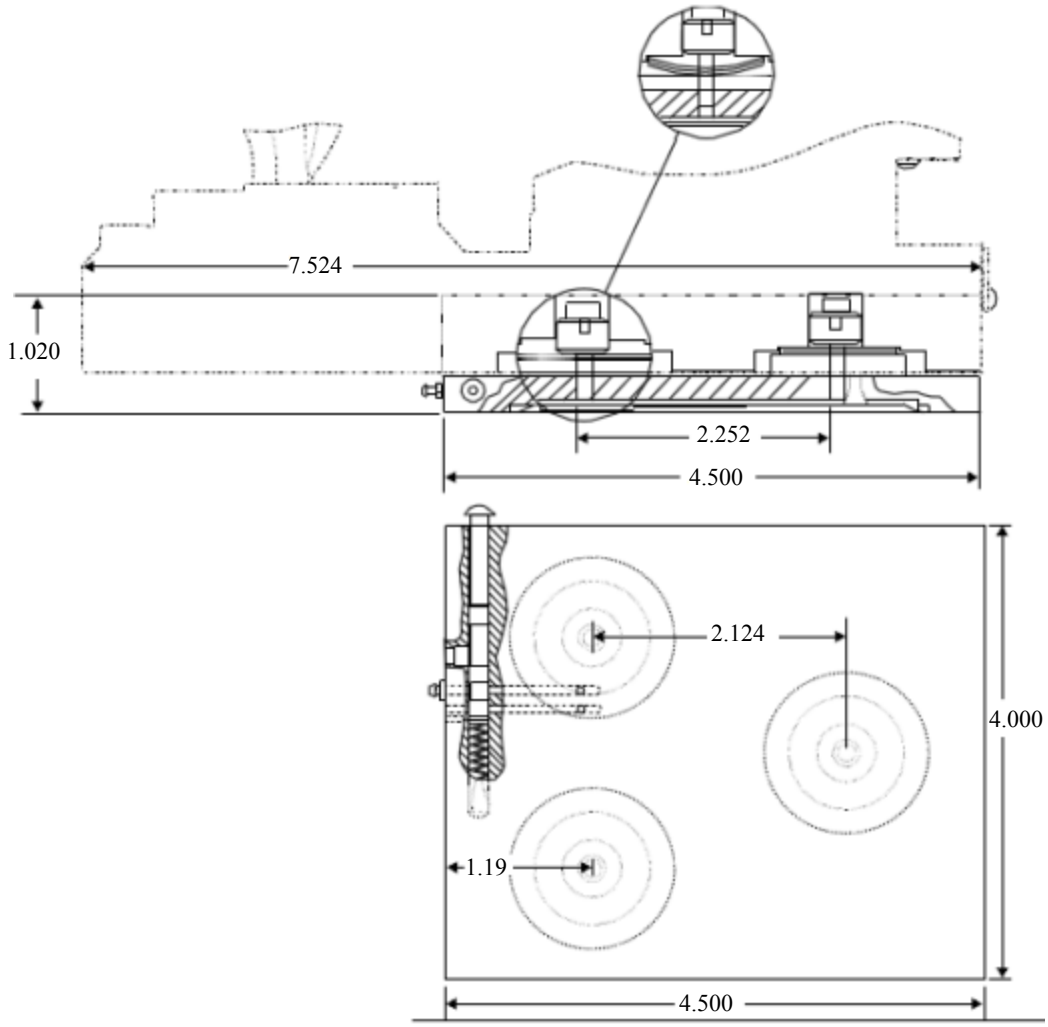


MAC-22 Vacuum Mount

Three (3) 6-32 x .50-inch mounting/adjustment screws are used to fasten the MAC-22 mount to the micropositioner. These screws are also used to planarize the positioner. The MAC-22 base is attached to the positioner as shown below.



MAC-22 Vacuum Base Dimensions



Planarizing

CAUTION

The probe station must be planarized before attempting positioner planarization. Take care when loosening the mounting/planarization screws for the x-and y-axis. Do not loosen the screws to the point that the mount is at risk of falling from the micropositioner.

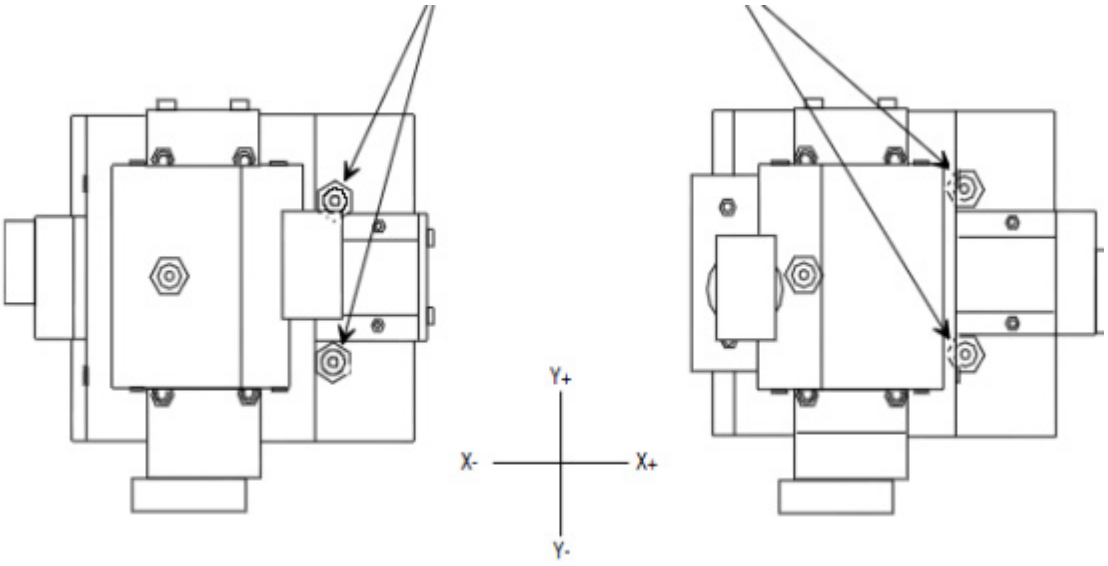
NOTE

Use the highest magnification (up to 500X) when planarizing.

Planarizing the Y-Axis

1. Move the probe to the negative end of the x-axis to expose the y-axis mounting screws.

Y axis mounting/planarization screws



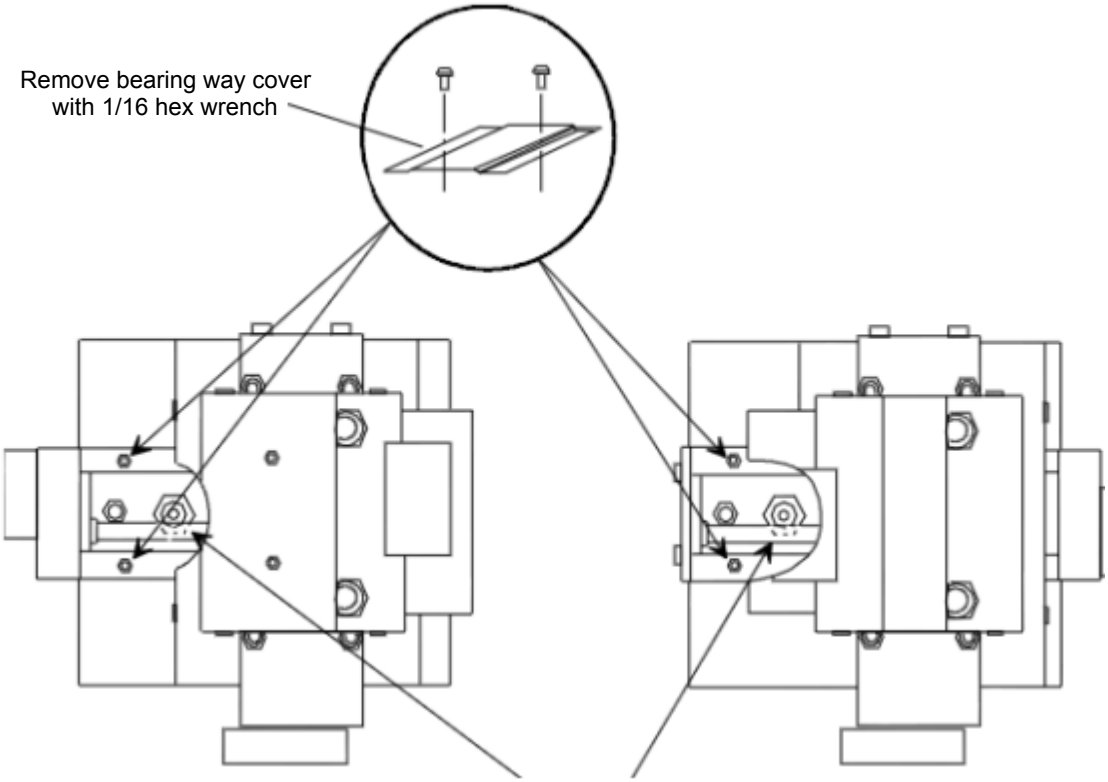
Left hand positioner

Right hand positioner

2. Move the positioner and the microscope to the positive end of the y-axis. Move the probe tip into the field of view. Focus the microscope on the probe tip.
3. Move the positioner to the negative end of the y-axis. If the probe tip stays in focus, the y-axis is planarized. If the probe tip is not in focus, continue on to step 4.
4. Using the 7/64-inch hex wrench, adjust the mounting/adjustment screw on the negative end (corresponding to the y-position of the scope) until the probe tip is in focus. DO NOT refocus the microscope.
5. Move the probe to the positive end of the y-axis. Turn the adjustment screw on the positive end until the probe tip is in focus.
6. Move the probe back and forth along the y-axis and continue making adjustments until the probe tip is in focus throughout travel to both ends.
7. Make sure that the mounts did not loosen excessively during planarization.
8. The y-axis is now planarized.

Planarizing the X-Axis

1. Move the probe to the negative end of the x-axis.



X axis mounting/planarization screws

2. Move the microscope to its negative limit on the x-axis. Move the probe tip into the field of view and focus the microscope.
3. Move the positioner and the microscope to the to the positive end of the x-axis. If the probe tip stays in focus, the x-axis is planarized. If the probe tip is not in focus, continue to step 4.
4. Remove the bearing way cover screws with a 1/16-inch hex wrench.
5. Use the 7/64-inch hex wrench to adjust the mounting/adjustment screw until the probe tip is in focus. DO NOT refocus the microscope.
6. Move the probe back and forth along the x-axis and continue making adjustments until the probe tip is in focus throughout travel to both ends.
7. Make sure that the mounts did not loosen excessively during planarization.
8. The x-axis is now planarized.

Chapter

4 Slide Mount for Summit 12K

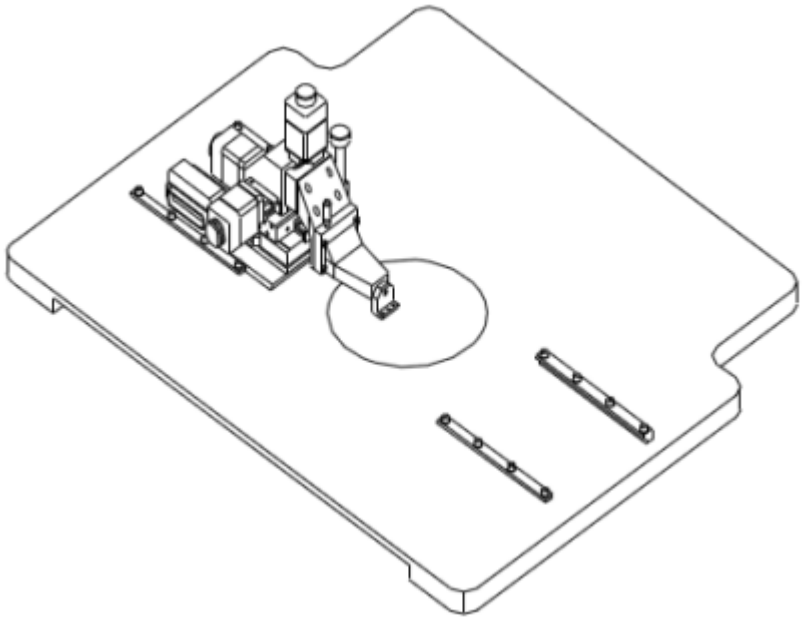
Installing the Slide Mount

The positioner should slide freely between two rails (bolted to the MicroChamber) until the lock knob is tightened.

Positioner Configurations

Rail and Single Positioner

The assembled rail and positioner configuration is shown with a single positioner installed.

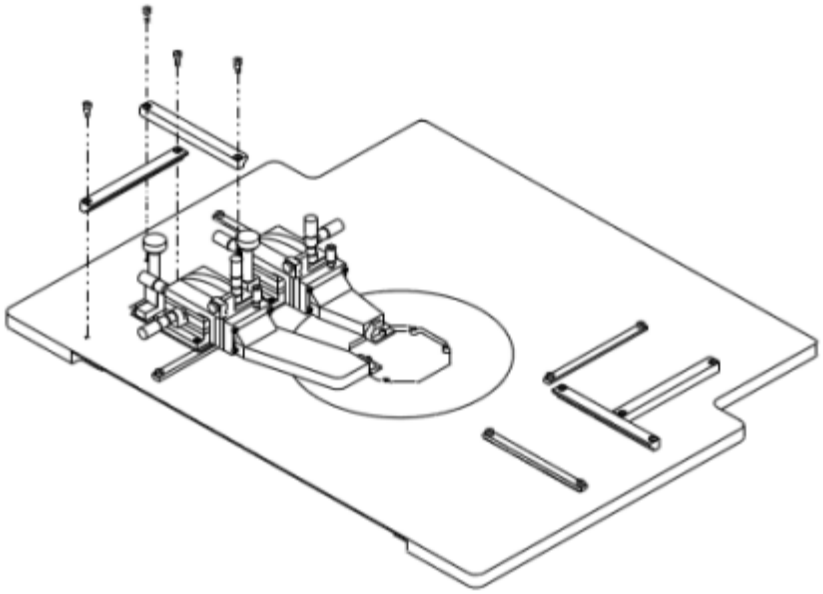


Rail and Double Positioners

Pre-drilled rail locations on the top of the Microchamber are shown with a left and a right positioner installed. The provided shoulder screws which bolt down the rails are:

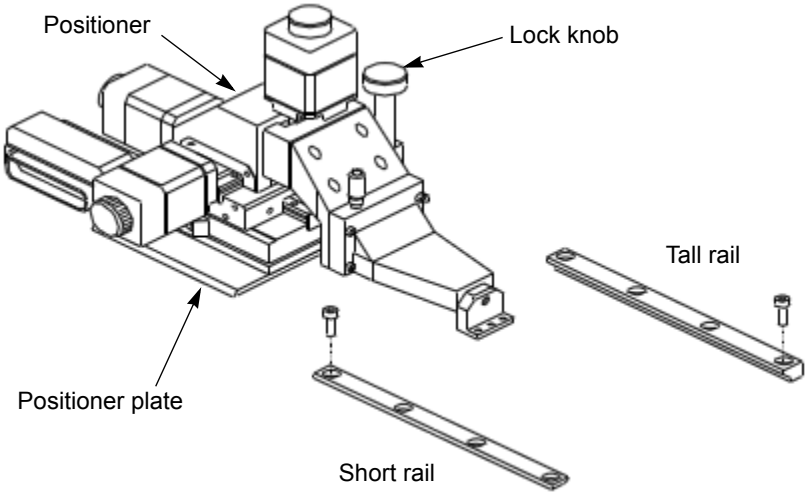
- Two (2) .187 dia x .313-inch long with 8-32 thread (long shoulder screws for the tall rail - PN 106-353)

- Two (2) .187 dia x .188-inch long with 8-32 thread (short shoulder screws for the short rail - PN 106-352)

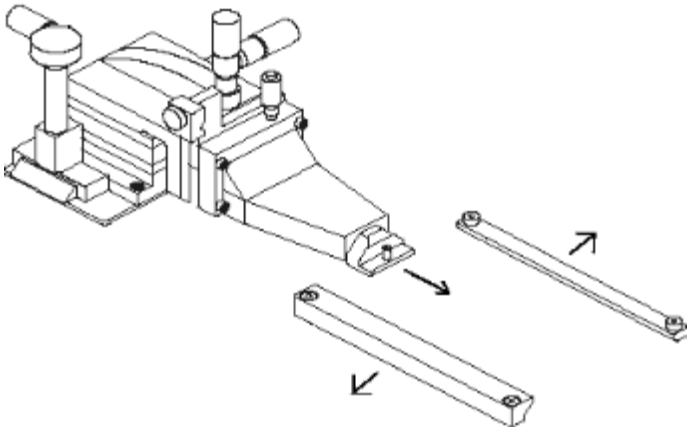


Installing the Rails

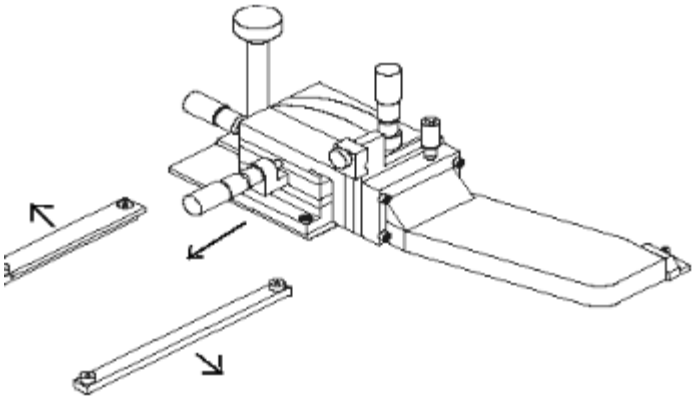
1. Install the short rail with two (2) short shoulder screws, but do not tighten them.
2. Turn the positioner lock knob three turns counter clockwise, or until it stops.
3. Slide the positioner in place.
4. Install the tall rail with two (2) long shoulder screws, but do not tighten them.
5. Push the rails apart from one another to take up any slack and tighten the screws.
6. The positioner plate should slide easily in the grooves formed by the rails and the Microchamber. To lock the positioner, tighten the lock knob in a clockwise direction. Do not overtighten the lock knob.



North-South Positioner



East-West Positioner



Initializing the Positioners

WARNING

Failure to follow these instructions can result in severe, irreparable damage to positioners.

1. Remove the Microchamber TopHat.
2. If necessary, rotate the platen ring insert so that the screw holes are on the top and bottom rather than on the sides (to avoid the risk of crashing the micropositioners into the screws).
3. Gently move the right micropositioner in Y to its right-most position, or the left micropositioner to its left-most position. Be careful not to crash into the platen ring insert.
4. Leave approximately 1 mm clearance between the back of the probe head and the inside edge of the platen ring insert.
5. Remove the probe head from the micropositioner.
6. Turn on the ECX box.
7. See your probe station control software user guide for information on configuring and calibrating your positioners.

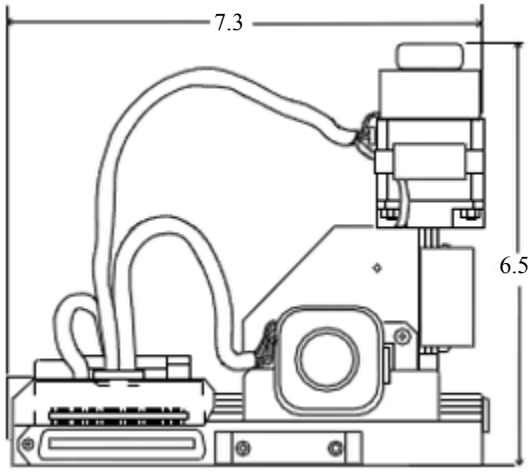
Appendix

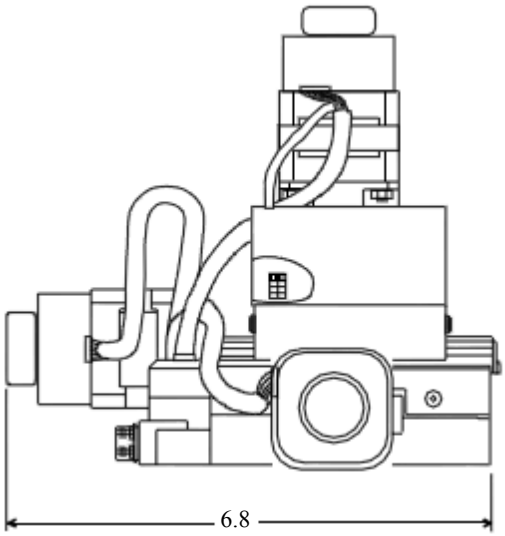
A Topic A

Micropositioner Specifications

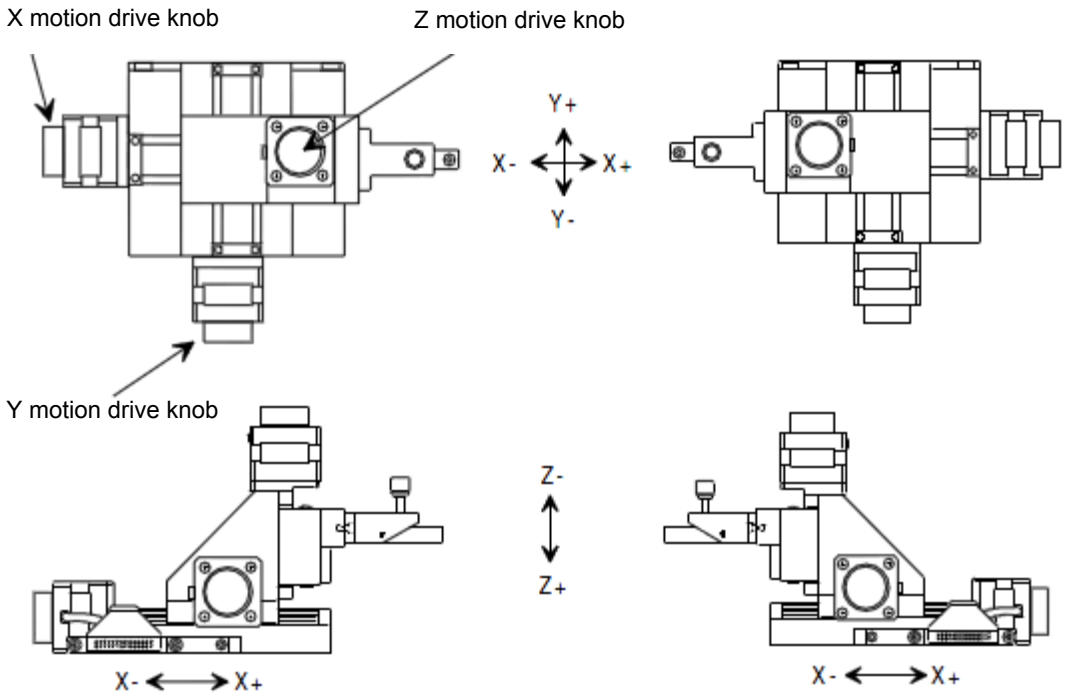
Specifications	MS1	MS2
X-axis travel	25.4 mm (1mm)	50.8 mm (2-inch)
Y-axis travel	25.4 mm (1-inch)	50.8 mm (2-inch)
Z-axis travel	15.3 mm (0.6-inch)	15.3 mm (0.6-inch)
Speed	1 mm/sec	1 mm/sec
Lead screw	0.4 mm	0.4 mm
Resolution	0.1 micron	0.1 micron
Repeatability	1 micron	2 micron
Accuracy	1 micron	3 micron
Motor	400 step 2 phase	400 step 2 phase

Micropositioner Dimensions





Axis Directions



Left hand axis designation

Right hand axis designation

Connector Pin Assignments

The MS-Series micropositioners contain a 50-pin male connector used to connect the joystick and software control to the positioner. The connector is located on the side of each positioner.

Right-Hand MS1 and MS2 Pin Assignments

Pin	Signal name	Wire color
1	X Phase A	Brown
2	X Phase C	Orange
3	X Phase B	Yellow
4	X Phase D	Red
5	X AC-CT	Black
6	X-BD-CT	White
7	Y Phase A	Brown
8	Y Phase C	Orange
9	Y Phase B	Yellow
10	Y Phase D	Red
11	Y AC-CT	Black

Pin	Signal name	Wire color
12	Y BD-CT	White
13	Z Phase A	Brown
14	Z Phase C	Orange
15	Z Phase B	Yellow
16	Z Phase D	Red
17	Z-AC-CT	Black
18	Z BD-CT	White
19	X + LIMIT	Brown
20	X - LIMIT	Yellow
21	Y + LIMIT	Green
22	Y - LIMIT	Red
23	Z + LIMIT	Orange
24	Z - LIMIT	White
25	Ground	Black
26-50	Reserved	Reserved

Left-Hand MS1 and MS2 Pin Assignments

Pin	Signal name	Wire color
1	X Phase A	Brown
2	X Phase C	Orange
3	X Phase B	Yellow
4	X Phase D	Red
5	X AC-CT	Black
6	X-BD-CT	White
7	Y Phase A	Brown
8	Y Phase C	Orange
9	Y Phase B	Yellow
10	Y Phase D	Red
11	Y AC-CT	Black
12	Y BD-CT	White
13	Z Phase A	Brown
14	Z Phase C	Orange
15	Z Phase B	Yellow
16	Z Phase D	Red
17	Z-AC-CT	Black
18	Z BD-CT	White
19	X + LIMIT	Brown
20	X - LIMIT	Yellow
21	Y + LIMIT	Green
22	Y - LIMIT	Red
23	Z + LIMIT	Orange
24	Z - LIMIT	White
25	Ground	Black
26-50	Reserved	Reserved

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