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User Guide

OrbitorRS2

Revision 004 (16-Oct-17)

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About This Guide

This guide explains how to operate and maintain the Orbitor mover device.

The Orbitor is used to move containers to and from other devices within an automated laboratory system. Such devices may include storage units, such as hotels, stacks, and incubators, as well as operational devices, such as imagers, readers, dispensers, washers, and shakers.

This guide provides information only for the Orbitor. For information regarding other devices or system automation software, refer to the relevant manufacturer's instructions.

Related Information

This guide is to be read in conjunction with the following documents:

- The *Orbitor Unpacking Guide*.
- The *Orbitor Installation Guide*.
- The *Momentum User Guide* (if the Orbitor is being integrated into a Momentum system).

Alerts and Notices Within This Guide

The following typographical conventions are used to identify important information within this guide:

Bold text indicates the name of a button, switch, or other control with which the user is being instructed to interact. (For example, "press the **Motor On** button.")

UPPERCASE text indicates the name of a mode or state in which a device or other component must be placed to ensure proper operation. (For example, "before continuing, ensure that main power is OFF".)

Bold, italicized text emphasizes important information which users must read and understand.

> ***TIP*** *Statements prefaced with this caption provide helpful information relevant to the current topic.*

NOTICE Failure to observe statements prefaced with this caption may result in damage to the system or other property.

CAUTION! Failure to observe statements prefaced with this caption may result in minor injury.

WARNING! Failure to observe statements prefaced with this caption may result in serious injury or death.

Contacting Customer Support

When contacting the Customer Support Group, be prepared to provide the following information:

- A clear description of the issue.
- The type and model of Orbitor involved.

- The Orbitor's serial number.
- Any errors or warning messages observed.
- The operating system of the computer used to control the Orbitor.
- Details on how to reproduce the problem, including specific steps and the circumstances surrounding the issue.

The Customer Support Group can be contacted by telephone, fax, or e-mail during the hours of 8am - 5pm, Eastern Standard Time (EST).

Phone and Email

Telephone: 289-313-1869
Toll-free (Canada and the U.S.): 800-365-7587 (when prompted, select Option Three)
Fax: 905-332-1114
Email: services.labautomation@thermofisher.com

Mailing Address

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Laboratory Automation
Thermo Fisher Scientific
5250 Mainway
Burlington, Ontario, L7L 5Z1
Canada

Safety

This chapter explains how to work safely with and around the Orbitor.

CAUTION! Failure to adhere to the information provided in this section may result in injury or property damage.

Intended Use

CAUTION! Using the Orbitor in any other way than as described below may create a safety risk and could compromise the warranty agreement.

The Orbitor is used to move containers to and from other devices within an automated laboratory system. Such devices may include storage units, such as hotels, stacks, and incubators, as well as operational devices, such as imagers, readers, dispensers, washers, and shakers.

The Orbitor is intended for indoor use in an environment that meets the specifications provided in the "Environmental Requirements" table on page 7.

Hazardous Materials

The Orbitor may only be used to handle radioactive, chemical, biological, or other hazardous materials after a full risk analysis has been completed and all resulting safety requirements have been implemented.

If used to handle hazardous materials, the Orbitor itself may become contaminated. Be aware of this when working with the Orbitor and ensure that all local government, industry, and facility safety regulations are observed.

CAUTION! Do not use the Orbitor to handle substances that are highly combustible or explosive, or which release combustible or explosive gases when exposed to the air.

Unsuitable Containers

Do not use the Orbitor to handle containers described by one or more of the following characteristics:

- The container exceeds the Orbitor's maximum payload when fully loaded. (See the "Physical Parameters" table on page 7.)
- The container is taller than 50 mm (2 in.).
- The container cannot be easily grasped by the Orbitor fingers. For example, containers which do not have walls on two sides or which have irregular walls. Also, containers that are too soft or which may warp easily when exposed to heat.
- The container sticks to other containers when stacked or when wet.

Safety During Handling and Installation

While transporting, installing, or otherwise handling the Orbitor, ensure that the following requirements are met:

- At least two people are required to carry the Orbitor.
- When lifting the Orbitor, grasp the base while another person grasps the top plate.

When setting it down, use care to avoid trapping fingers beneath the base.

- Do not lift the Orbitor by its arm. This may cause damage.
- When moving the Orbitor to a new location, ensure that the shipping locks are installed. (See the *Orbitor Installation Guide*.)

Safety During Operation

When working with or around the Orbitor, ensure that the following safety requirements are met:

- Only trained and authorized personnel may work with or around the Orbitor.
- In addition to any other personal protective equipment required by local government, industry, and facility regulations, impact-rated safety glasses must be worn at all times while working with or around the Orbitor.
- When working with or around the Orbitor, do not wear loose clothing or jewelry, long, unbound hair, or anything else that may be easily caught by the Orbitor while it is moving.
- The Orbitor is a fully automated device that may move at any time while under the control of Momentum or another system automation management application.

  Remain outside the Orbitor's workspace when it is in operation.
- Ensure that the Orbitor's control puck is positioned within easy reach and outside of the Orbitor's workspace.
- If the Orbitor is being operated without having been secured to the supporting surface (such as during a demonstration), the master speed setting must be reduced to 20% or less.
- If the Orbitor's workspace includes guarding, ensure that it is in place at all times while the Orbitor is in operation.
- Do not attempt to handle the Orbitor while it is under the control of Momentum or a similar system automation management application. Doing so may result in injury.
- A fully populated random-access hotel or sequential-access stack can weigh significantly more than when empty. Use care when moving a populated hotel or stack, and do not attempt to load one beyond its maximum capacity.

Halting Operation

If a safety risk or other concern requires that the Orbitor immediately stop operation, remove power to the motors that control its movement by pressing the **Motor Off** button located on the control puck. The Motor On button goes dark and the Orbitor is no longer under motor control.

Safety Requirements for Third-Party Integrators

If the Orbitor is being integrated into a system by a party other than Thermo Fisher Scientific, that integrator must ensure that the following safety requirements are met:

- The integrator must ensure that the system automation management software that will oversee the Orbitor's operation is fully compatible with the Orbitor and capable of ensuring its safe and proper use.
- The integrator must train operators in the Orbitor's proper use and maintenance.
- The integrator must complete a full Safety Risk Assessment in accordance with all relevant local government, industry, and facility regulations.

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Specifications

This chapter provides a physical description of the Orbitor.

Working With the Orbitor

To understand the tasks described in this guide, users must recognize the different parts of the Orbitor.

The following diagram identifies each part of the Orbitor as they are referred to in this guide.

TIP *The end of the Orbitor's arm which includes the barcode reader is referred to as the 'reader end' of the arm.*

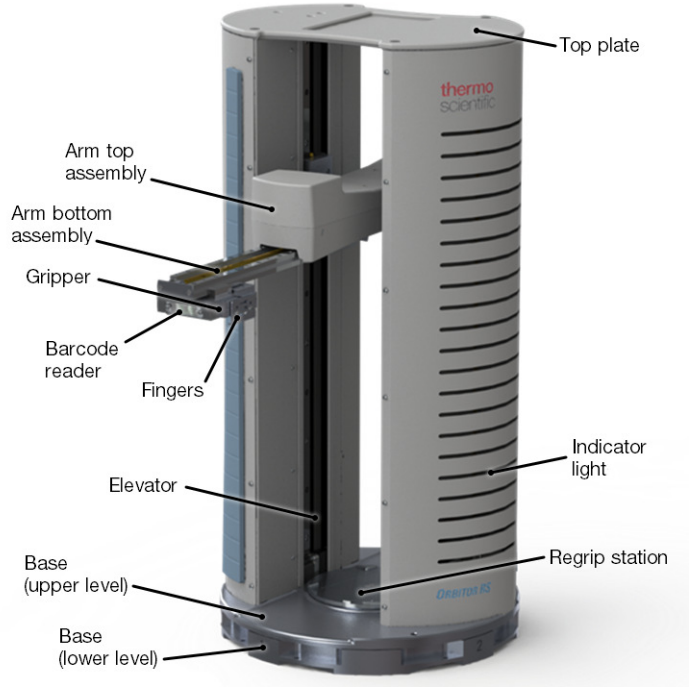

Figure: Orbitor Diagram

Design Summary

The following tables provide the Orbitor's physical parameters and requirements.

Table: Physical Parameters

Parameter	Value
Measurements	
Height	724 mm (28.5 in.)
Weight	25 kg (55 lbs)
Workspace	
Vertical (above supporting surface)	16 - 591 mm (0.6 - 23.2 in.)
Horizontal (diameter)	820 mm (32.2 in.)
Gripper	
Maximum payload	320 g (11.3 oz)
Distance (closed - open)	75 - 130 mm (2.97 - 5.13 in.)
Maximum closing force	8.9 N (32 ozf)
Container type	SBS standard
Container orientation	Landscape or portrait

Table: Environmental Requirements

Parameter	Value
Max. ambient operating temp.	15 - 40°C (59 - 104°F)
Storage temperature	-20 - 60°C (-4 - 140°F)
Humidity	20 - 80% RH up to 31°C (88°F), decreasing linearly to 50% RH at 40°C (104°F). Max 80% RH non-condensing.
Atmosphere	Office/laboratory environment (clean, low-dust, and dry)
Maximum operating altitude	2,000 m (6,560 ft) above sea-level
Installation location	For indoor use only
Voltage power requirement	100 - 240 +/- 10% VAC auto-switching

Table: Movable Components

Parameter	Base	Elevator	Arm (Reach)
Joint travel	Infinite	570 mm (22.4 in.)	±410 mm (±16.4 in.)
Maximum joint speed	225 degrees/sec	750 mm/sec	1,200 mm/sec
Maximum joint acceleration	675 degrees/sec^2	2,250 mm/sec^2	3,600 mm/sec^2
Position resolution	±0.00375 degrees/count	0.005625 mm/count	±0.009 mm/count
Maximum holding torque/force	9.2 Nm (48 N with arm fully retracted; 20 N with arm fully extended)	87.4 N	6.5 N

The following table provides information for the random-access hotels and sequential-access stacks provided with the Orbitor.

Table: Stack and Hotel Parameters

Parameter	Value
Random-Access Hotels	
Weight (empty)	2.1 kg (4.6 lbs)
Capacity	8 shelves
Sequential-Access Stacks (Hinge-Style)	
Weight (empty)	7 kg (15.4 lbs)
Approximate weight (full)	14.6 kg (32.1 lbs)
Approximate Capacity	40 containers (varies with container height)
Sequential-Access Stacks (Rod-Style)	
Weight (empty)	2.1 kg (4.6 lbs)
Approximate weight (full)	9.7 kg (21.3 lbs)
Approximate Capacity	40 containers (varies with container height)

Preparing for Operation

This chapter explains how to prepare the Orbitor for operation.

At this point, the Orbitor should have already been installed, configured, and tested. Before performing any of the procedures described in this section, ensure that all installation and initial startup procedures have been completed successfully, as described in the *Orbitor Installation Guide*.

To prepare the Orbitor for operation, perform the following procedures in the order in which they are provided.

Energizing the Orbitor

Before the Orbitor may be operated using the controlling software, it must be energized using the control puck.

Procedure: If the Orbitor has not already been energized, do so now by performing the following steps:

TIP *For more information about the controls used in this procedure, see "Using the Control Puck" on page 13.*

1. Ensure that the Orbitor's power and communication cables are securely connected to the ports on the Orbitor base.

2. Confirm that the Orbitor's power cable is connected to a suitable power outlet, and that its communication cable is connected to the correct port on the computer which controls the Orbitor.

3. To turn on main power and energize the Orbitor's internal control modules, set the control puck's **DC Power** switch to ON (•). Main power is now ON.

4. Ensure that the **Motor Off** button is not pressed in. If it is, turn it clockwise until it springs back out.

5. Energize the motors by pressing the **Motor On** button. The button glows green and the Orbitor is now under motor control.

Initializing the Orbitor

After the Orbitor has been energized, it must be initialized. This procedure may be performed using either Momentum or MoverTeach.

Using Momentum to Initialize the Orbitor

Because Momentum manages the entire automated system, initializing the Orbitor involves bringing the entire system online as a whole.

If only the Orbitor should be brought online at this time, use MoverTeach to initialize it, rather than Momentum. (See "Using MoverTeach to Initialize the Orbitor" on page 10.)

Alternatively, Momentum may be used to bring only the Orbitor online by first deactivating all other devices in the system, setting them to Simulate mode, or selecting to keep them offline if they display an error during initialization. For more information, see the *Momentum User Guide*.

Procedure: To use Momentum to initialize the Orbitor, perform the following steps:

1. Open Momentum.

2. In the **Run** ribbon's **Work** section, select the **Normal** button. Momentum begins initializing the system, including the Orbitor and all other devices controlled by Momentum.

3. If the Orbitor was energized successfully (see "Energizing the Orbitor" on page 9), Momentum confirms that the Orbitor is powered and is able to communicate with Momentum. If an error is encountered during this process, Momentum displays a message. If this occurs, correct the error, and then select **Retry starting the device**. If the error was corrected successfully, Momentum continues initialization.

4. After confirming that the Orbitor is powered and able to communicate, Momentum homes the Orbitor (that is, moves it to the Safe location), and then confirms that the nest location(s) of any device(s) with which the Orbitor will interact during operation are known.

5. If this is the first time that the Orbitor has been initialized, the nest locations checked by Momentum during the previous step have not yet been taught and an error message appears. If this occurs, complete the initialization process by selecting **Resume starting**. The process resumes and the Orbitor is initialized.

Using MoverTeach to Initialize the Orbitor

Procedure: To use MoverTeach to initialize the Orbitor, perform the following steps:

1. Open MoverTeach. At this time, most of the features in the MoverTeach screen will be unavailable, and will remain so until MoverTeach has connected with the Orbitor.

2. In the MoverTeach menu bar, under **Mover**, select **Connect to [Orbitor's Name]**. The features of the MoverTeach window become active and the Motion Database field is populated with information for this Orbitor. The Orbitor's indicator light glows blue, and the status bar at the bottom of the screen indicates that power is OFF and that the Orbitor is not homed.

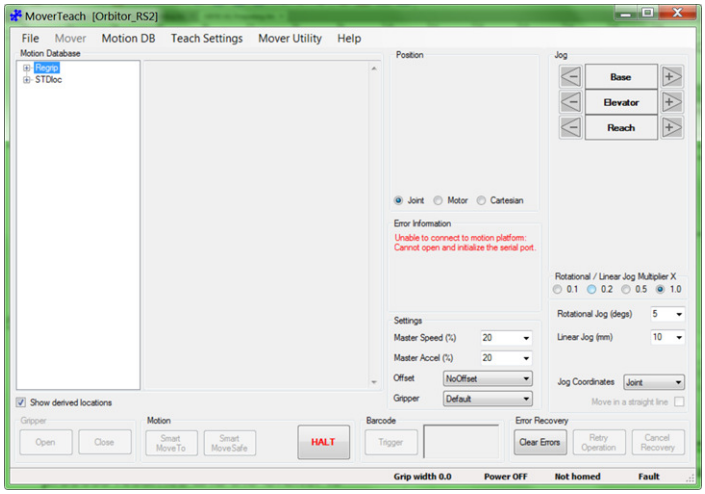

Figure: MoverTeach Screen on Startup

3. In the MoverTeach menu bar, under **Mover Utility**, select **Turn Power On**. Each of the Orbitor's joints moves slightly, and the status bar changes from "Power Off" to "Power On".

CAUTION! The Orbitor will move when the following step is performed. Stand clear before continuing.

4. In the MoverTeach menu bar, under **Mover Utility**, select **Home All Axes**. Each of the Orbitor's joints moves as it recognizes the current location and orientation of each movable component. The Orbitor then moves to the Safe location. After this procedure has been completed, the status bar changes from "Not Homed" to "Homed". The Orbitor is initialized and ready for operation.

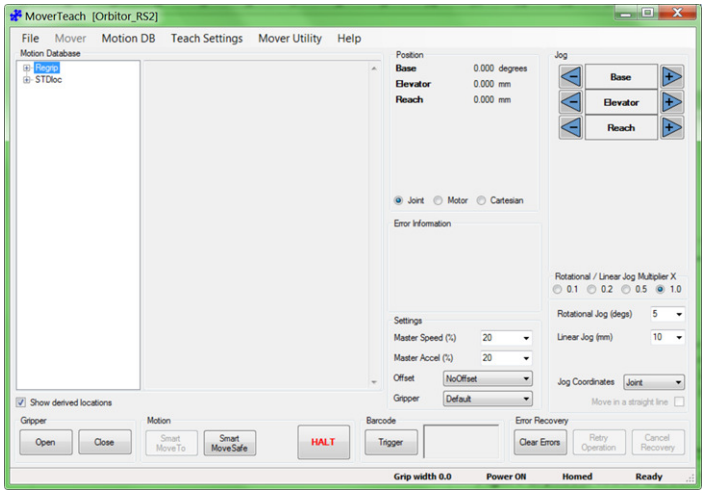

Figure: MoverTeach Screen With Mover Homed and Power On

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Controlling the Orbitor

This chapter explains how to control the Orbitor's operation.

The Orbitor can be controlled using the following methods:

- Directly, using the Orbitor's control puck.
- Directly, using MoverTeach.
- Remotely, using Momentum.

The control puck is used to control power to the Orbitor, while the controlling software (Momentum or MoverTeach) is used to manage its actions during operation.

Many of the procedures described in this guide require users to perform tasks involving both the control puck and the controlling software. For example, to prepare the Orbitor for operation, it must first be energized (using the control puck), and then initialized (using the controlling software).

Using the Control Puck

The control puck includes the following features:

- The DC Power switch.
- The Motor On button.
- The Motor Off button.

Figure: Control Puck

DC Power Switch

To energize the Orbitor's internal control modules, set the **DC Power** switch to ON (•). To de-energize the modules, press the opposite (unlabeled) side of the switch.

The DC Power switch does not control power to the motors which control the Orbitor's movement, however, it must be set to ON in order for the controls which do energize the motors to function.

The control modules manage a variety of activity, including communication with the computer and motor operation.

> ***TIP*** *When the DC Power switch is set to OFF, the internal control modules lose any information that they had acquired during operation.*

Motor On Button

To energize the motors that control the Orbitor's movement, press the **Motor On** button. Pressing

this button will enable the Orbitor to move if the appropriate commands are given.

The Motor Off button must be reset for the Motor On button to function.

Motor Off Button

To de-energize the motors, press the **Motor Off** button. The button will remain pressed in and will prevent the Orbitor from moving until it is reset.

To reset the Motor Off button, turn it clockwise until it springs back out. Resetting the button will not immediately restore power to the Orbitor. To do so, after resetting the **Motor Off** button, press the **Motor On** button.

Using the Controlling Software

The Orbitor's operation is controlled using either Momentum or MoverTeach.

Momentum Momentum is a system automation scheduling application which coordinates the actions of the individual devices in an automated system.

MoverTeach The MoverTeach application is used to control an individual mover, such as the Orbitor. MoverTeach can be used in conjunction with Momentum, another system automation management application, or instrument-specific software. It may also be used as a stand-alone tool for controlling a mover.

Most of the procedures described in this guide are performed using the Orbitor's controlling software, and many may be performed using either Momentum or MoverTeach. In such cases, the procedure varies depending on the application being used, so both versions of the procedure are provided.

To avoid confusion, ensure that the correct version is being followed, depending on whether the procedure is being performed using Momentum or MoverTeach.

Understanding Limping

The Orbitor is 'limped' when motor control is removed from the joints, allowing the Orbitor to be moved safely by hand. This method is useful when the Orbitor must be moved quickly into a general position or location.

For example, when teaching the Orbitor the location of a new nest, the Orbitor may be limped and moved by hand so that the gripper is in the general location of the nest. Motor control is then restored, allowing the precision control needed to move the gripper into the exact position required to place a container in the nest.

Handling the Orbitor While Limped

When handling the Orbitor while it is limped, observe the following precautions:

> ***TIP*** *For an illustration showing the individual Orbitor parts mentioned below, see the "Orbitor Diagram" figure on page 7.*

NOTICE Failure to observe the following precautions may result in damage to the Orbitor.

NOTICE When moving the Orbitor arm by hand, grip the arm's top assembly. Gripping the bottom assembly while moving the arm may cause damage.

- Although the Orbitor joints will move freely when limped, handle the Orbitor with care and avoid any sharp, jerking motions.

- The elevator is counterweighted, so there will be a small amount of resistance, even when the elevator is limped.

- If the elevator joint is limped while the Orbitor is holding a container weighing more than approximately 250 g (8.8 oz), the Orbitor arm may begin to lower due to the weight.

Limping the Orbitor

Using MoverTeach, the Orbitor's joints may be limped all together or individually, as required.

Limping and Unlimping All Joints Simultaneously

Procedure: To limp all joints simultaneously, perform the following steps:

1. In MoverTeach, ensure that the Orbitor has been initialized. (See "Using MoverTeach to Initialize the Orbitor" on page 10.)

2. In the **Mover Utility** menu, select **Limp All Axes**. A warning notice appears. (This notice is a general warning presented for all movers and does not apply to the Orbitor.)

3. Select the **Yes** button. All joints are limped and MoverTeach's jog controls are disabled.

Procedure: To unlimp all joints at once, in the **Mover Utility** menu, select **Unlimp All Axes**. The Orbitor is unlimped and MoverTeach's jog controls are restored.

Limping and Unlimping Joints Individually

Procedure: To limp an individual joint, perform the following steps:

1. In MoverTeach, ensure that the Orbitor has been initialized. (See "Using MoverTeach to Initialize the Orbitor" on page 10.)

2. In the **Jog Coordinates** dropdown menu, select **Joint**.

3. Right-click on the jog control for the joint that will be limped (base, elevator, or reach), and then select **Limp Axis**. The selected joint is limped and the jog control for that joint is disabled.

Procedure: To unlimp an individual joint, right-click on the jog control for the joint that will be unlimped (base, elevator, or reach), and then select **Unlimp Axis**. The selected joint is unlimped and the jog control for that joint is restored.

Moving the Orbitor by Direct Command

Typically, the Orbitor's movement is overseen by Momentum, which issues commands in accordance with an automated process.

In some cases, however, it may be necessary to control the Orbitor's movements directly, such as when using MoverTeach to teach it a new nest location.

Using MoverTeach, the user may issue movement commands directly to the Orbitor.

Understanding Jog Control Types

There are three jog control types available:

- Joint.

- Cartesian.

- Tool.

Each control type is based on a different set of coordinates. The jog controls (located in the upper-right of the MoverTeach window) are used

to control the Orbitor's movement, and change to reflect the coordinates of the control type that is currently selected.

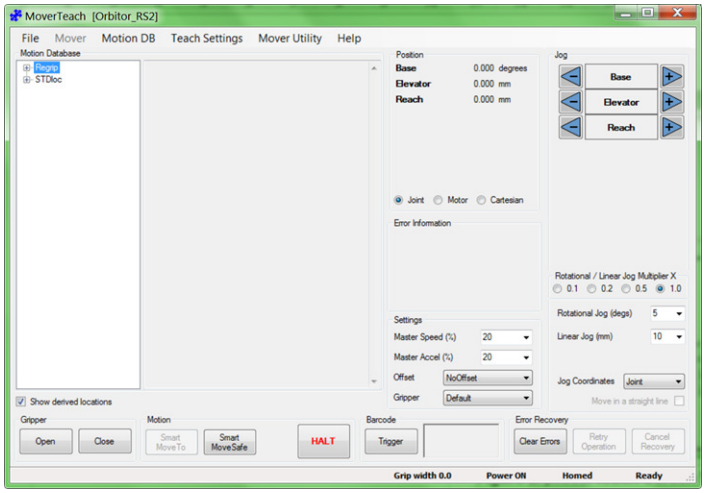

Figure: MoverTeach Window

> ***TIP*** *Although the difference between Joint and Tool jog control types can be significant with other movers, the Orbitor's behavior under these types is identical.*

Each jog control type allows the Orbitor to be moved in a different way, meaning that the ideal control type will vary depending on the situation.

For example, if the Orbitor must be moved quickly to a general location, the Joint control type would be most useful, whereas the Cartesian control type is better-suited for smaller, more precise movements.

Joint Jog Control Type

When the Joint jog control type is selected, the jog controls reflect the positioning of each of the Orbitor's movable joints, and can be used to either rotate or extend/retract a joint, as applicable.

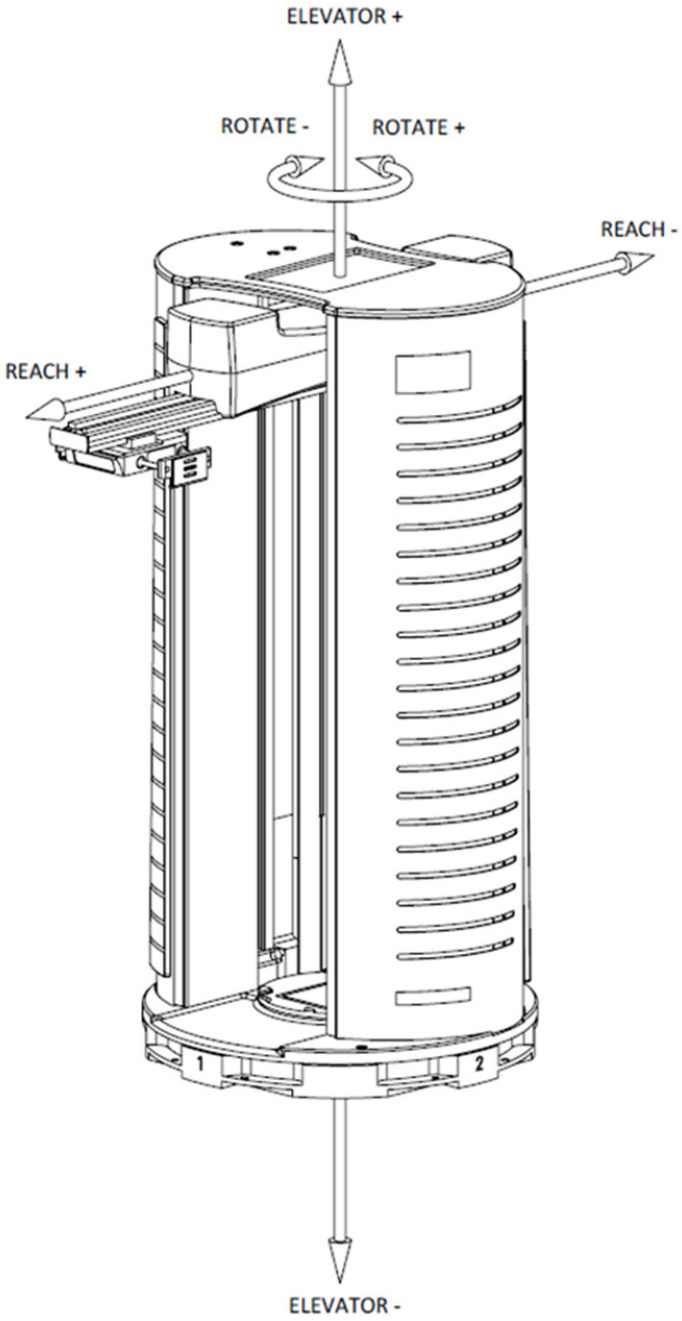

Figure: Joint (Jog Control) Movement

The following table provides the Joint jog controls and their impact on the Orbitor's motion.

Table: Joint Jog Controls

Control	Positive (+) Button	Negative (-) Button
Base	Rotates the base counter-clockwise	Rotates the base clock-wise
Elevator	Raises the elevator	Lowers the elevator
Reach	Moves the arm forward	Moves the arm back-ward

Compared to the Cartesian jog control type, Joint is useful for quickly moving the Orbitor into a general position, such as turning the base to face the direction of a device, or adjusting the elevator to match the general height of a nest.

Cartesian Jog Control Type

When the Cartesian jog control type is selected, the jog controls reflect the Orbitor's motion along the three axes of a Cartesian frame of reference (X, Y, and Z).

The jog controls also reflect a mover's rotation along these three axes (Xrot, Yrot, and Zrot), however, the Orbitor is not capable of moving in this manner.

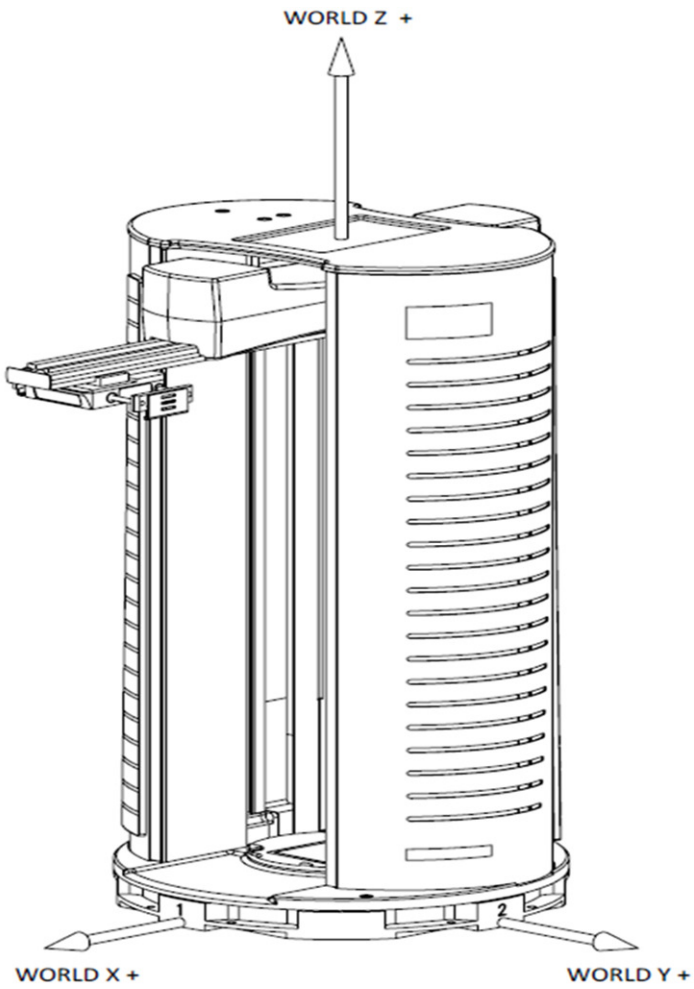

Figure: Cartesian (Jog Control) Movement

Each axis stems from a central point of origin. This point is located in the center of the Orbitor base. Both the central point of origin and the overall frame of reference remain stationary, regardless of how the Orbitor moves.

For example, the X axis reflects the Orbitor's forward and backward motion, with "forward" always facing the front of the base's lower level (which does not rotate). The Orbitor arm is moving forward when it is facing this direction, and backward if it turns to face the opposite direction.

Unlike Joint controls, which reflect the position of each individual joint, Cartesian controls reflect the location of the center-point between the

Orbitor gripper in regard to the central point of origin.

TIP *Although the Xrot, Yrot, and Zrot controls are available in MoverTeach, the Orbitor is not capable of rotating along these axes. (Though other movers controlled by MoverTeach can.) As such, these controls have no effect on the Orbitor's motion.*

The following table provides the Cartesian jog controls and their impact on the Orbitor's motion.

Table: Cartesian Jog Controls

Control	Positive (+) Button	Negative (-) Button
X	Moves the finger center-point forward	Moves the finger center-point backward
Y	Moves the finger center-point left	Moves the finger center-point right
Z	Moves the finger center-point up	Moves the finger center-point down
Zrot	N/A	N/A
Yrot	N/A	N/A
Xrot	N/A	N/A

Compared to the Joint jog control type, Cartesian is useful for movements that are more focused than those performed using Joint, but not as precise as those performed using Tool. (For example, moving the gripper to the general location of a device's nest, but not necessarily aligning it with the nest.)

Tool Jog Control Type

When the Tool jog control type is selected, the jog controls reflect the Orbitor's motion along the three axes of a Cartesian frame of reference (X, Y, and Z).

The jog controls also reflect a mover's rotation along these three axes (Yaw (Z axis), Pitch (Y axis), and Roll (X axis), however, the Orbitor is not capable of moving in this manner.

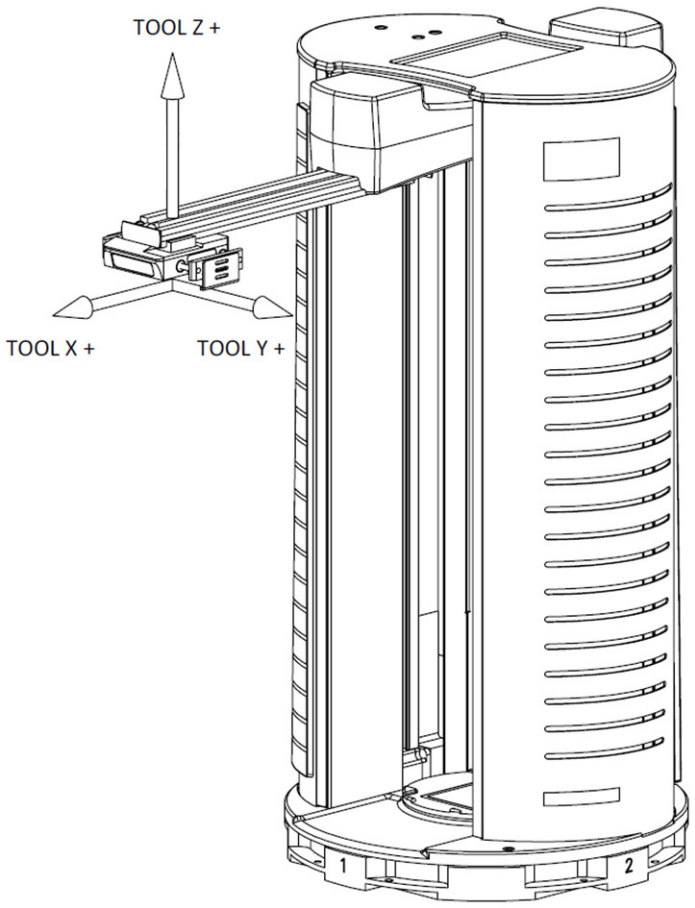

Figure: Tool (Jog Control) Movement

As with the Cartesian control type, each axis stems from a central point of origin. However, with Tool, this point is located at the center-point between the Orbitor fingers, rather than the center of the Orbitor base.

As such, the Tool central point of origin and the overall frame of reference moves with the finger center-point as the Orbitor moves. When a command to move is received, the difference between the current central point of origin and the requested location is calculated. The Orbitor then moves the finger center-point to this new location. This location then acts as the central point of origin for the next move command.

TIP *Although the Yaw, Pitch, and Roll controls are available in MoverTeach, the Orbitor is not capable of rotating along these axes. (Though other movers controlled by MoverTeach can.) As such, these controls have no effect on the Orbitor's motion.*

The following table provides the Tool jog controls and their impact on the Orbitor's motion.

Table: Tool Jog Controls

Control	Positive (+) Button	Negative (-) Button
X	Moves the finger center-point forward	Moves the finger center-point backward
Y	Moves the finger center-point left	Moves the finger center-point right
Z	Moves the finger center-point up	Moves the finger center-point down
Yaw	N/A	N/A
Pitch	N/A	N/A
Roll	N/A	N/A

Choosing a Jog Control Type

Procedure: To choose a jog control type, in the **Jog Coordinates** dropdown menu, select either **Joint**, **Tool**, or **Cartesian**, as needed. The jog controls (located in the upper-right of the window) change to display the selected set of controls.

Displaying Location Values

The values representing the Orbitor's current location are displayed to the left of the jog controls. There are three distinct sets of values which may be displayed, depending on the current display setting.

Joint The Joint display setting shows either the current degree of rotation or the current height of each of the Orbitor's three joints, as applicable.

Motor The Motor display setting shows the current positioning of each of the Orbitor's three motors.

TIP *The Cartesian display setting uses the Cartesian jog control type's central point of origin regardless of the jog control type currently selected. (See "Understanding Jog Control Types" on page 15.)*

Cartesian The Cartesian display setting shows the current Cartesian coordinates of the center-point between the Orbitor fingers in relation to the central point of origin. (See "Cartesian Jog Control Type" on page 17.)

Only one set of values may be displayed at any given time.

Procedure: To change the display setting, select either the **Joint**, **Motor**, or **Cartesian** option button, as needed.

Controlling the Gripper

If necessary, the gripper can be commanded to open or close the fingers. The gripper controls are found in the lower-left corner of the MoverTeach window.

Procedure: To open or close the gripper fingers, in MoverTeach, select either the **Open** or **Close** button, as needed.

Using the Jog Controls to Move the Orbitor

In addition to the jog controls themselves (see "Understanding Jog Control Types" on page 15), there are additional control features which will affect how the Orbitor moves when commanded through MoverTeach.

Linear Jog The linear jog value impacts how far (in millimeters) the Orbitor elevator and reach joints

move per movement command. This value also affects motion along linear axes when the Cartesian and Tool jog control types are selected. (See “Understanding Jog Control Types” on page 15.)

Rotational Jog The rotational jog value impacts how much (in degrees) the base joint rotates per movement command.

Jog Multiplier The linear and rotational jog values are multiplied by the selected jog multiplier value. (In most cases, this value is set to 1.0 unless very precise movements are required.)

Ensuring that these values are set correctly before issuing a move command will reduce the risk of a collision.

Procedure: To use the jog controls to move the Orbitor, perform the following steps:

TIP *Typically, higher linear and rotational jog values are used for longer, more generalized movements, while lower values are used for shorter, more precise movements.*

1. Confirm that the linear and rotational jog values are correct.

2. Confirm that the selected jog multiplier value is correct.

3. In the Jog Coordinates dropdown list, select either **Joint**, **Cartesian**, or **Tool**, as needed. (See “Choosing a Jog Control Type” on page 19.)

4. Ensure that the desired set of location values (Joint, Motor, or Cartesian) is displayed. (See “Displaying Location Values” on page 19.)

5. If the Orbitor will be commanded to pick up a container during this session, ensure that the fingers are fully open. (See “Controlling the Gripper” on page 19.)

6. For each jog control that will be used during this session, test the related settings by selecting either the control’s positive (+) or negative (-) button, and then observing the Orbitor’s movement. Note the direction in which it moves and how much the joint moves, and then make any necessary changes to the settings defined in the previous steps.

7. After confirming the performance of each jog control that will be used during this session, use the controls as needed to move the Orbitor to the desired location.

Using the Regrip Station

The regrip station is located in the center of the Orbitor base. (See the "Orbitor Diagram" figure on page 7.)

The regrip station is used whenever the Orbitor must change the orientation of a container which it is moving.

For example, if the Orbitor gets a container from a portrait-oriented hotel nest and will be putting the container in the landscape-oriented nest of a reader, after getting the container, the Orbitor can set it in the regrip station’s portrait orientation, reposition itself to the station’s landscape orientation, and then pick up the container before continuing on to the reader’s nest.

During runs overseen by Momentum, this process is typically automated and requires no action from the user. If MoverTeach is being used to control the Orbitor’s movement, however, users may need to complete the regrip process manually.

NOTICE If the Portrait regrip location has not yet been confirmed, do so now before continuing. (See “Confirming the Portrait Regrip Location” on page 29.)

Procedure: To use the regrip station while controlling the Orbitor with MoverTeach, perform the following steps:

1. Ensure that the container is located in a nest location that has been taught. (See “Teaching Locations” on page 27.)

1. In MoverTeach’s Motion Database field, expand the **[Device Name]** section and its **locations** subsection for the device where the container is currently located.

2. Right-click the name of the nest where the container is located, and then select **Get Plate Into Gripper**. The Orbitor moves to the nest, picks up the container, and then moves it to the nest’s nest.safe location. (See “Location Types” on page 28.)

3. In MoverTeach’s Motion Database field, expand the **Regrip** section and its **locations** subsection. Two locations, Landscape and Portrait, are available.

4. Move the Orbitor to the regrip location that matches the way in which the Orbitor is currently gripping the container. To do so, right-click either the **portrait** or **landscape** location, as applicable, and then select **Put Plate Into Nest**. The Orbitor places the container in the regrip station in the selected orientation, and then moves to the station’s nest.safe location.

5. Right-click the new location (either **portrait** or **landscape**, as appropriate), and then select **Get Plate Into Gripper**. The Orbitor moves to the regrip station, picks up the container in the selected orientation, and then moves it to the station’s nest.safe location.

Using the Barcode Reader

The Orbitor’s integrated barcode reader may be used to identify specific containers by reading (decoding) barcode labels.

Supported Barcode Types

The following table provides the barcode types which the reader can interpret.

Table: Supported Barcode Types

Code Type	
1D Codes	
Codabar	NEC 2 of 5
Code 39	Straight 2 of 5
Code 93	Interleaved 2 of 5
Code 128	MSI Plessey
GS1	Telepen
Matrix 2 of 5	
2D Codes	
Data Matrix	

Guidelines and Requirements for Barcode Reading

The following sections explain how to ensure that the barcode reader is able to identify and decode barcodes.

Optimizing Barcode Design

Barcode labels should be designed according to the following specifications:

- For best contrast and performance, print barcodes in black ink and on white labels.

- Labels must use a barcode type that is supported by the barcode reader. (See “Supported Barcode Types” on page 21.)
- Barcodes should be no longer than 32 characters.
- Barcodes should be large enough to allow adequate contrast between light and dark bands. To ensure that the barcode can be viewed clearly by the Orbitor when in the read location, all barcodes should be 5.8 x 33 mm for an eight-character figure (scale as needed for figures with more or less than eight characters).

Figure: Acceptable (Top) and Unacceptable (Bottom) Barcode Sizes

- When applying a barcode label to the side of a container, ensure that the label is centered as much as possible. If at all possible, the edges of the label should be 12 mm away from the edges of the container side.
- There must be adequate white space on either side of the barcode pattern. This space should be equal to 6 mm on either side, or ten times the width of the smallest bar in the barcode pattern (whichever is greater.)

Optimizing Reading Conditions

When using the barcode reader, ensure that the following requirements are met:

- Ensure that lighting conditions have been optimized. (See “Optimizing Lighting Conditions for Barcode Reading” on page 23.)
- The barcode reader can read labels applied to the container on either a portrait or a landscape side, however, there will be approximately 21 mm difference in distance between the reader and a label on the portrait side of a container versus one on a landscape side.
- The barcode reader will decode up to five barcode patterns simultaneously if they all appear within the decoding window. (See “Positioning for Barcode Reading” on page 22.)

Positioning for Barcode Reading

When capturing a barcode image, the Orbitor moves to the read location associated with the nest where the container bearing the barcode has been positioned.

Read locations (designated by “.read” in the Motion Database) are extrapolated locations based on the related nest locations, and do not need to be manually taught by the user. (See “Sections and Subsections” on page 27.)

Because an image captured from a nest’s read location may also include the barcode labels for containers in nearby nests, The barcode reader only decodes a portion of the overall image.

Figure: Barcode Reader Decoding Window

This portion is between scan lines 328 and 568. Barcodes that appear in the image, but which are not within the image's decoding window, will not be decoded. Barcodes that appear partially within the decoding window may be decoded, depending on how much of the barcode pattern is in the window, and the clarity of that portion.

As a general rule, approximately 30% of a barcode pattern must appear within the decoding window in order for the barcode to be decoded.

Optimizing Lighting Conditions for Barcode Reading

There are several environmental factors that can impact the barcode reader's ability to decode a barcode pattern.

When preparing to use the barcode reader, ensure that the following conditions have been met:

- The location should be lit primarily by artificial light, rather than natural light, which may vary.
- The amount of light should be equivalent to what would normally be found in an office or laboratory setting.
- Ensure that the barcode pattern is uniformly lit. (That is, free of shadow edges and not exposed to significantly brighter light on one side than on the other.)
- Ensure that the barcode pattern is fully visible to the barcode reader. (That is, not obscured by nest locators or other obstacles.)

Triggering the Barcode Reader

Procedure: To command the barcode reader to capture an image, in MoverTeach, select the **Trigger** button found at the bottom of the MoverTeach window.

Testing the Barcode Reader

There are two ways to test the barcode reader's performance: By performing a test capture (used primarily by end-users), and by running a test script (used primarily by integrators).

Performing a Test Capture

To test the barcode reader's performance by conducting a test capture, perform the following steps:

1. Place a container with a well-defined barcode label (see "Optimizing Barcode Design" on page 21), in a nest which has been taught. (See "Teaching New Locations" on page 30.)
2. In MoverTeach, move the Orbitor to the nest's .bcread location. (See "Moving the Orbitor by Direct Command" on page 15.)
3. In MoverTeach's Barcode section, select the **Trigger** button. The barcode reader captures an image of the container.

If the container's barcode is successfully read, the barcode value appears in the field next to the Trigger button.

If the barcode value does not appear in the field, recapture the image. If the value still does not appear, ensure that the barcode label and reading conditions have been opimized, as described in the sections above.

If the barcode value is still not being captured under optimal conditions, reteach the nest, and then retest.

Using a Test Script

The following script can be used to determine whether the barcode reader can decode a barcode in a specific nest location:

```
set nest Inst1:nest[1]
smartmoveto ${nest}.read
if $LOOPS == 1
  set FName BarcodeTest_($DATE_NAME)
  setlogfile ${FName}.txt
  logassert
endif
captureimage ${FName}.jpg
targetIndicator 0
set i 1
loop 10
  ReadCode
  if $N_CODES
    echo $i: $CODE[0]
  else
    echo $i: NoCode
  endif
  setexpr i $i + 1
endloop
echo end
setlogfile
```

This script can be executed using MoverTeach's Test Tool.

TIP *If the nest being tested includes both landscape and portrait orientation options, perform a separate test for each orientation.*

Procedure: To use the test script to determine whether the barcode reader can decode a barcode, perform the following steps:

1. Place a container with a well-defined barcode label (see "Optimizing Barcode Design" on page 21), in a nest which has been taught. (See "Teaching New Locations" on page 30.)

2. In MoverTeach, select **Test Tool** in the **Mover Utility** menu. The Test Tool window appears.

3. Enter the script provide above into the Test Tool's script field.

4. In the script, replace the text "Inst1:nest[1]" with the name of the nest that will be tested.

5. To run the script, select the **Start** button. After a brief pause, the test is completed and the resulting output files are generated.

The test script generates two output files:

- A report file detailing the results of the test. The file is named "BarcodeTest" followed by the date and time that the test was performed. (For example, "BarcodeTest_(20160808_1429).txt)".)

- The image file captured during the test. The file is named using the same convention as the accompanying report file. (For example, "BarcodeTest_(20160808_1429).jpg)".)

These output files are generated at the following location:

C:\Program Files (x86)\Thermo Scientific\Mover Framework.

Shutting Down the Orbitor

Procedure: To shut down the Orbitor, perform the following steps:

1. Ensure that the Orbitor is in the Safe location. (See “Moving the Spinnaker by Direct Command” on page 15.)
2. In MoverTeach, under the **Mover** menu, select **Disconnect**. Communication with the Orbitor is ended, the Orbitor’s indicator light goes dark, and many of the MoverTeach features become inactive.
3. Close MoverTeach.
4. At the Orbitor control puck, remove power to the Orbitor’s motors by pressing the **Motor Off** button. The Motor On button goes dark.
5. Remove main power to the Orbitor by setting the **DC Power** switch to OFF. The Orbitor is shut down.

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Teaching Locations

This chapter explains how to teach new locations to the Orbitor.

Understanding Locations and Teaching

A location is a point in space which the Orbitor has been taught and to which it can move. A location may be a point where the Orbitor performs an action, such as placing a container in the nest of a device, or it may be one of several points along the route which the Orbitor takes while moving to such a location.

Teaching is the process of instructing the Orbitor about a location. It is one of the first actions performed with an Orbitor after it has been integrated within a system.

Understanding the Motion Database

All locations that have been taught to the Orbitor are stored in the MoverFramework Motion Database.

Sections and Subsections

The database sorts information about locations first by device or function, and then by information type.

Database sections are defined by the device or overall function to which they relate. When the Orbitor is first installed, the database includes two factory-taught sections, Regrip and STDloc.

Regrip The Regrip section contains information relating to the Orbitor regrip station.

STDloc The STDloc (standard location) section contains information relating to general locations that are either related to the system as a whole or that are specific to the Orbitor, such as its Safe location.

Device Sections Each time a new device is added to the system, the locational information related to that device is stored in a section named after that device. For more information about adding devices to MoverTeach, see the *MoverTeach User Guide*.

Information contained within each section is further divided into the following standard subsections:

Locations Specific points in space which the Orbitor has been taught and to which it can move.

Extrapolations Rules used to create one location by using another location as a starting point. An extrapolation defines the distance and direction from the starting location, and the resulting point is stored as a new location. For example, the transit[0] location for a nest may be determined by extrapolating from that nest location.

> ***TIP*** *Interpolations are performed after extrapolations. This means that a location cannot be extrapolated based on an interpolated location.*

Interpolations Rules used to determine one or more locations based on the spacing between two taught locations. For example, based on the locations of Nests One and Eight, an

interpolation determines the locations of Nests Two through Seven.

Speeds Values that determine the Orbitor's speed when it moves between locations.

Paths Path values define a safe route which the Orbitor may use when moving between two locations.

Regions A region defines a set of locations which the Orbitor may move safely between. For example, the safeRegion value in the STDloc section lists the Safe and Regrip locations as ones which the Orbitor may move between safely, without risk of collision.

Location Types

There are four types of locations used to determine a safe path by which the Orbitor approaches a device's nest.

Safe A location in the general area of the device. The Orbitor moves to the device's Safe location before beginning its approach toward the nest.

NOTICE Device control is released as the Orbitor reaches the nest.safe location. This location must be far enough from the device that the Orbitor will not interfere with the device's operation.

Nest.safe A location in the general area of the nest. The Orbitor moves from the device's Safe location to the nest.safe location as the first step in its approach toward the nest. If a device has multiple nests, each nest has its own nest.safe location.

Transit A transit location is a point to which the Orbitor moves during its approach from the nest.safe location to the nest. The number of transit locations along this route depends on the type of device, its location within the system, and the number of nests it contains.

Nest The location where the Orbitor places and retrieves a container.

The following diagram shows the approach path for a device with a single nest. Due to its configuration and location within the system, the Orbitor must move to two transit points as it approaches the nest.

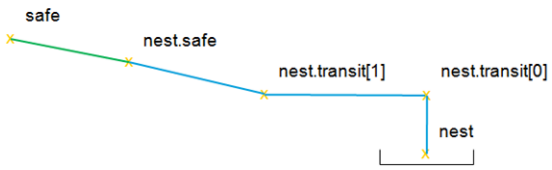

Figure: Approach Diagram (Single Nest With Multiple Transits)

The following diagram shows the approach path for a device with multiple nests, such as a random-access hotel. Due to its configuration and location within the system, the Orbitor must move to only one transit location when approaching each nest.

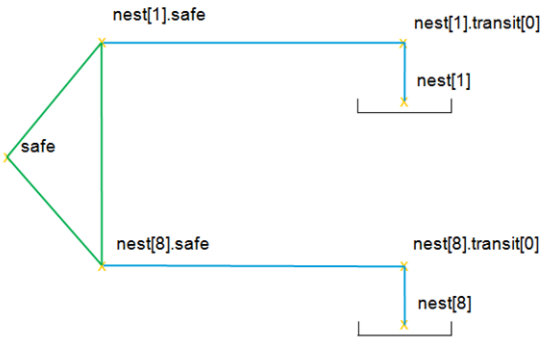

Figure: Approach Diagram (Multiple Nests With Single Transits)

Requirements for Teaching

To teach new locations, the following conditions must be met:

- The Orbitor has been installed, configured, and tested. (See the *Orbitor Installation Guide*.)
- The device containing the nest that is to be taught has been added to MoverTeach's list of devices.
- The Orbitor has been initialized and is ready for operation. (See "Initializing the Orbitor" on page 9.)
- The Portrait regrip location has been confirmed. (See "Confirming the Portrait Regrip Location" on page 29.)

Confirming the Portrait Regrip Location

Although the Portrait regrip location is taught before the Orbitor leaves the factory, the Orbitor must be installed before this location can be taught with enough precision to allow the Orbitor to pick up a container placed in the regrip station.

As such, the Orbitor may move to the Portrait location, but this location must be retaught in order to confirm that the Orbitor is positioned as needed to pick up a container.

Because the regrip station is often used as the starting location during teaching sessions, the Portrait regrip location should be confirmed before any other locations are taught.

TIP *The Landscape regrip location a derived location and does not need to be confirmed. (See "Location Types" on page 28.)*

Procedure: To confirm the Portrait regrip location, perform the following steps:

TIP *For more information about the MoverTeach controls mentioned below, see "Moving the Orbitor by Direct Command" on page 15.*

1. Place the Teach Jig in the regrip station's portrait orientation.
2. In MoverTeach's Motion Database field, expand the **Regrip** section and its **locations** subsection. The Portrait location is available.

NOTICE If the Orbitor has been moved manually (either by using the jog controls or by hand), use the **MoveTo** command to return it to a taught location (such as the Safe location) before using the SmartMoveTo command. Failure to do so may result in the Orbitor moving to an incorrect location.

3. Move the Orbitor to the Portrait regrip location by right-clicking the **portrait** location, and then selecting **SmartMoveTo**. The Orbitor's arm moves so that the gripper is positioned in a portrait orientation above the regrip station.
4. Adjust the Orbitor's position as needed to align the gripper fingers with the dimples on the sides of the Teach Jig. The Orbitor may be moved either by limping it (see "Limping the Orbitor" on page 15) or by issuing direct move commands (see "Moving the Orbitor by Direct Command" on page 15).

5. After positioning the Orbitor, in MoverTeach, close the gripper fingers by selecting the **Close** button. If it does not appear that the teeth on the fingers have aligned with the dimples on the Teach Jig, open the fingers, reposition the Orbitor, and repeat this step until the teeth and dimples are aligned.

6. Right-click the **portrait** location, and then select **Teach Joint Location**. The coordinates for the Orbitor's current location are saved to MoverTeach's temporary memory.

7. To test whether the Orbitor has gripped the Teach Jig securely, move it to the Safe location by selecting the **SmartMoveSafe** button in the **Motion** section of the MoverTeach window. If the Teach Jig falls while the Orbitor is moving or if it does not appear secure, repeat the previous steps until successful.

8. After the Teach Jig has been moved to the Safe location successfully, return the Teach Jig to the regrip station by right-clicking the **portrait** location, and then selecting **SmartMoveTo**. The Orbitor returns to the Portrait regrip location.

9. In MoverTeach, open the gripper fingers.

10. Return the Orbitor to the Safe location.

11. Test the newly taught location by right-clicking the **portrait** location, and then selecting **Get Plate Into Gripper**. If the newly taught position is accurate, the Orbitor moves to the Portrait regrip location, picks up the Teach Jig, and then moves it to the portrait.safe location. If the Orbitor fails to pick up the Teach Jig, or if it drops the Teach Jig after doing so, repeat the teaching procedure until successful.

12. Update the Motion Database by selecting **Recalculate Derived Locations in All Sections** in the **Motion DB** menu. All derived locations in the Motion Database are recalculated based on the newly confirmed location.

13. After the Portrait regrip location has been tested successfully, transfer the new Portrait regrip location data from MoverTeach's temporary memory to the Motion Database by selecting **Save Motion Database** in the **Motion DB** menu. The Portrait regrip location has been confirmed.

Teaching New Locations

To teach a new location, perform the following procedures in the order in which they are provided.

> ***TIP*** *For more information about the MoverTeach controls mentioned below, see "Moving the Orbitor by Direct Command" on page 15.*

Preparing to Teach

Before a new location can be taught, the Teach Jig must be held securely by the gripper fingers (known as "getting the Jig").

In most cases, the following procedure will involve getting the Teach Jig from the regrip station. If the Portrait regrip location has not yet been confirmed, do so now before continuing. (See "Confirming the Portrait Regrip Location" on page 29.)

Procedure: To get the Teach Jig, perform the following steps:

1. Place the Teach Jig in the Orbitor regrip station's portrait or landscape orientation, depending on the orientation of the nest location that will be taught.

2. In MoverTeach's Motion Database field, expand the **Regrip** section and its **locations** subsection. Two locations, Landscape and Portrait, are available.

3. Get the Teach Jig by right-clicking either the **landscape** or **portrait** location, as applicable, and then selecting **Get Plate Into Gripper**. The Orbitor moves to the selected regrip location, picks up the Teach Jig, and then moves it to the Safe location.

Teaching a New Location

After the Teach Jig is held securely in the gripper fingers, the Orbitor is ready for teaching.

The Orbitor may be taught using either the MoverTeach (recommended in most cases) or Locomotion application.

Teaching Using MoverTeach

MoverTeach is the standard application used to teach locations for the Orbitor in most cases.

The alternative application, Locomotion, is intended for use by those who rarely teach locations and/or who are working with an Orbitor that has not been secured to a work surface (and which may require frequent reteaching as a result, due to shifting during operation).

Procedure: To teach a new location using MoverTeach, perform the following steps:

TIP *If moving the Orbitor by direct command, consider using the Joint jog control type to move the Teach Jig into the general area of the nest, and then the more precise Cartesian type to position the Teach Jig in the nest. (See "Choosing a Jog Control Type" on page 19.)*

1. Move the Orbitor so that the Teach Jig is positioned in the nest location that is being taught. The Orbitor may be moved either by limping it (see "Limping the Orbitor" on page 15) or by issuing direct move commands (see "Moving the Orbitor by Direct Command" on page 15).

2. Ensure that the Teach Jig is positioned properly in the nest before continuing. When doing so, consider the following:

   - If the nest includes locators or other positioning aids, ensure that these are used to position the Teach Jig.

   - If the nest does not include locators or other positioning aids, ensure that the Teach Jig is centered in the nest.

   - Gently tap the top of the Teach Jig to determine if it is sitting flush against the floor of the nest.

   - Slide a piece of paper or a card between the sides of the Teach Jig and the sides or positioning aids of the nest. Check if there is equal space on all opposite sides of the Teach Jig.

   - If the Orbitor is limped, ensure that the Teach Jig sits level in the nest by gently tapping the Orbitor arm's top assembly.

- Quickly open and close the gripper fingers. (See “Controlling the Gripper” on page 19.) If the Teach Jig moves, adjust its position to minimize movement.

3. After confirming that the Teach Jig has been positioned properly, in MoverTeach, expand the **[Device Name]** section and its **locations** subsection.

4. In the **locations** subsection, right-click the location that is being taught, and then select **Teach Joint Location**. The coordinates for the Orbitor’s current location are saved to MoverTeach’s temporary memory.

5. If there are other locations that are derived from the newly taught location, recalculate those locations by performing one of the following steps:

   - If the other location(s) derived from this location are all associated with the same device, recalculate them by right-clicking the **[Device Name]** section, and then selecting **Recalculate Derived Locations**. All derived locations associated with that device are recalculated based on the newly taught location.

   - If one or more locations that are derived from this location are associated with other devices (that is, if they are stored in a different section of the Motion Database than this location), update the entire Motion Database by selecting **Recalculate Derived Locations in All Sections** in the **Motion DB** menu. All derived locations in the Motion Database are recalculated based on the newly taught location.

NOTICE If the Orbitor has been moved manually (either by using the jog controls or by hand), use the **MoveTo** command to return it to a taught location before using the SmartMoveSafe command. Failure to do so may result in the Orbitor moving to an incorrect location.

6. Return the Orbitor to the Safe location by selecting the **SmartMoveSafe** button in the **Motion** section of the MoverTeach window. The Orbitor moves the Teach Jig to the Safe location.

TIP *For alternative testing methods to those described in the following steps, see “Alternative Testing Methods” on page 33.*

7. To test the Orbitor’s ability to set the Teach Jig in the newly taught location, in the **[Device Name]** section’s **locations** subsection, right-click the **[nest name]** location, and then select **Put Plate Into Nest**. If the newly taught position is accurate, the Orbitor moves to the nest location, sets the Teach Jig securely in the nest, and then moves to the nest.safe location. If the Orbitor fails to place the Teach Jig properly, repeat the teaching procedure until successful.

8. After the Teach Jig has been placed securely in the nest location, return the Orbitor to the Safe location.

9. To test the Orbitor’s ability to get the Teach Jig from the newly taught location, in the **[Device Name]** section’s **locations** subsection, right-click the **[nest name]** location, and then select **Get Plate Into Gripper**. If the newly taught position is accurate, the Orbitor moves to the nest location, gets the Teach Jig, and then moves it to the nest.safe location. If the Orbitor fails to pick up the Teach Jig or if it

drops the Teach Jig after doing so, repeat the teaching procedure until successful.

10. After the newly taught location has been tested successfully, transfer the new location data from MoverTeach's temporary memory to the Motion Database by selecting **Save Motion Database** in the **Motion DB** menu. The new location has been confirmed.

Teaching Using Locomotion

Although it is generally recommended that users teach using MoverTeach, an alternative teaching application known as Locomotion is available and may be preferable in certain situations.

Users who rarely teach locations and/or who are working with an Orbitor that has not been secured to a work surface (and which may require frequent reteaching as a result, due to shifting during operation) may prefer to use Locomotion.

Locomotion is a sub-application of MoverTeach and cannot be accessed directly from the Windows Start menu. To make it easier to access Locomotion, it is recommended that users create a shortcut on the Windows desktop.

Procedure: To create a shortcut for the Locomotion application, perform the following steps:

1. Right-click anywhere on the desktop, and then select **Shortcut** under **New**. The Create Shortcut window appears.

2. Browse to the MoverTeach.exe file (C:\Program Files (x86)\Thermo Scientific\MoverFramework\MoverTeach.exe").

3. Add "--simplified" to the end of the filepath, and then select the **Next** button.

4. Name the shortcut, and then select the **Finish** button. The shortcut appears on the desktop.

Compared to MoverTeach, Locomotion provides a simplified, workflow-style interface intended solely for teaching locations. To teach a location using Locomotion, open the application, and then perform the steps described in Locomotion's screens.

Alternative Testing Methods

The teaching procedure described above (see) uses the Put Plate Into Nest and Get Plate Into Gripper commands to test newly taught locations. These commands issue multiple movement commands at once to the Orbitor and make it easy for users to test locations.

Depending on the amount of control and involvement that a user wants to have during testing, the alternative methods described below may be used instead of these commands.

Using Direct Commands

Users who want more direct control over the Orbitor's actions while testing may do so by manually issuing the movement commands which Put Plate Into Nest and Get Plate Into Gripper issue as automated sequences.

Using this method, the user moves the Orbitor to the nest and Safe locations using the related SmartMoveTo commands, and uses the gripper commands to open and close the gripper fingers. (See "Moving the Orbitor by Direct Command" on page 15.)

Using a Script

Users who want to simplify the test process by automating it entirely may do so by writing a script.

Scripts can be written and executed using MoverTeach's Test Tool, which is accessed by selecting **Test Tool** in the **Mover Utility** menu.

Maintenance

This chapter explains how to clean the Orbitor, and how to ensure that it remains in proper working order.

CAUTION! Only trained and authorized personnel may repair the Orbitor. If it appears to be damaged, contact the Customer Support Group. (See "Contacting Customer Support" on page 1.)

Safety During Maintenance

When performing the maintenance tasks described below, ensure that the following safety information is observed:

WARNING! Failure to adhere to the following information may result in serious injury or death.

- Do not attempt to disassemble the Orbitor power supply adapter or any other electrical components. Doing so may result in a lethal electric shock.
- Before cleaning the Orbitor, ensure that it has been completely de-energized and disconnected from the power supply.

Scheduling Service

To ensure that the Orbitor remains in proper working condition, it must undergo a maintenance inspection once per year.

This inspection may only be performed by a qualified Thermo Fisher Scientific technician.

For more information about maintenance inspections and other related services, contact the Customer Support Group. (See "Contacting Customer Support" on page 1.)

Cleaning the Orbitor

Ensuring that the Orbitor remains clean is a necessary part of its regular care and maintenance.

NOTICE Do not autoclave any part of the Orbitor.

Cleaning Spills

The Orbitor should be cleaned immediately following a spill due to a collision or other upset.

Procedure: To clean the Orbitor following a spill, perform the following steps:

> ***TIP*** *For more information about the Orbitor controls mentioned in the following procedure, see "Using the Control Puck" on page 13.*

CAUTION! The Orbitor must be de-energized before it may be cleaned. Failure to do so may result in injury.

1. De-energize the Orbitor motors by pressing the **Motor Off** button.
2. Remove all power to the Orbitor by setting the **DC Power** switch to OFF.
3. Ensure that power has been removed from the Orbitor by disconnecting the power cord from the power outlet.

4. If the Orbitor is adjacent to any random-access hotels and/or sequential-access stacks, remove them and set them aside in a safe location before continuing.

5. Using an absorbent, lint-free cloth, gently soak up any spilled liquids on or around the Orbitor. When doing so, avoid direct contact with any electrical components, such as the power connection on the Orbitor base.

6. Replace any hotels and/or stacks that were removed earlier.

After the Orbitor is clean and dry, operation may resume. (See “Energizing the Orbitor” on page 9.)

Periodic Cleaning

Regardless of how often the Orbitor is in operation, it should be cleaned at least once per month in order to remove any dust or debris that may eventually interfere with normal operation.

Procedure: To ensure that the Orbitor is free of any dust or debris, perform the following steps:

TIP *For more information about the Orbitor controls mentioned in the following procedure, see “Using the Control Puck” on page 13.*

CAUTION! The Orbitor must be de-energized before it may be cleaned. Failure to do so may result in injury.

1. De-energize the Orbitor motors by pressing the **Motor Off** button.

2. Remove all power to the Orbitor by setting the **DC Power** switch to OFF.

3. Ensure that power has been removed from the Orbitor by disconnecting the power cord from the power outlet.

4. Lightly dab a sponge or soft, lint-free cloth in a solution of water mixed with a mild detergent. (Alternatively, a mild isopropyl alcohol-based cleaning agent may also be used.) Ensure that the sponge or cloth is only damp (well-wrung and no longer dripping) before continuing.

5. Gently wipe the surface of the Orbitor, removing any dust or debris which may have accumulated. When doing so, avoid direct contact with any electrical components, such as the power connection on the Orbitor base.

6. If the Orbitor is connected to a base plate that supports any random-access hotels and/or sequential-access stacks, remove the hotels and/or stacks and clean them separately using the same sponge or cloth and cleaning solution.

7. Before replacing the hotels and/or stacks, clean and dry the base plate.

8. After ensuring that the base plate is dry, replace any hotels and/or stacks removed earlier.

After the Orbitor is clean and dry, operation may resume. (See “Energizing the Orbitor” on page 9.)

Testing the Safety Controls

In order to ensure that the Orbitor can be stopped quickly and easily, should the need arise, the controls used to do so (located on the Orbitor control puck) must be tested regularly.

This test should be performed either once per month or each time the Orbitor is power-cycled, whichever is more frequent.

TIP *For more information about the Orbitor controls mentioned in the following procedure, see "Using the Control Puck" on page 13.*

Procedure: To test the Orbitor's power controls, perform the following steps:

1. To turn on main power and energize the Orbitor's internal control modules, set the control puck's **DC Power** switch to ON (•). Main power is now ON.
2. Ensure that the **Motor Off** button is not pressed in. If it is, turn it clockwise until it springs back out.
3. Energize the motors by pressing the **Motor On** button. The button glows green and the Orbitor is now under motor control.
4. De-energize the motors by pressing the **Motor Off** button. The **Motor On** button goes dark and the Orbitor is no longer under motor control.
5. Reset the **Motor Off** button by turning it until it springs back out.
6. De-energize the Orbitor by setting the **DC Power** switch to OFF.

Replacing the BenchTrak MoverLink Fuse

The following information is relevant only for Orbitors that are mounted on a BenchTrak mover platform.

Should the fuse for the BenchTrak MoverLink box require replacement, refer to the following specifications when ordering new parts:

Table: BenchTrak MoverLink Box Fuse Specifications

Parameter	Value
Fuse rating	5 A/125 V FAST
Size	5 x 20 mm
Manufacturer part number	Littelfuse 0235005.HXP

Disposing of the Orbitor

When disposing of the Orbitor, ***European Union customers*** must adhere to all requirements as stated in the Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC.

Within the European Union, the Orbitor may not be disposed of via municipal waste collection or a similar service.

For more information about how to properly dispose of the Orbitor, contact your local vendor or the Thermo Scientific Customer Support Group. (See "Contacting Customer Support" on page 1.)

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