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INSTRUCTION MANUAL

MTM-3

Motorized Stereotaxic Frame

Serial No._____

www.wpiinc.com

111416

CONTENTS

ABOUT THIS MANUAL

The following symbols are used in this guide:

This symbol indicates a CAUTION. Cautions warn against actions that can cause damage to equipment. Please read these carefully.

This symbol indicates a WARNING. Warnings alert you to actions that can cause personal injury or pose a physical threat. Please read these carefully.

NOTES and TIPS contain helpful information.

Fig. 1–The **MTM-3** *motorized stereotaxic frame comes with the touch screen controller (left). An hand controller (right) is also included.*

INTRODUCTION

When precision and repeatability of motion are critical, the **MTM-3** Motorized Stereotaxic Frame outperforms manual models, and it greatly reduces human error. The motorized axes of the **MTM-3** provide precise, controlled, 3-dimensional placement of any probe or accessory within the working space of a stereotaxic frame. No computer is required. Single and dual manipulator arm motorized systems are available.

Features

The **MTM-3** offers increased precision and repeatability of motion over traditional manual Stereotaxic frames:

- Accurate microstepping motor drive for high resolution placement
- Set the "final approach" speed between 2mm/sec and 0.02mm/sec

Additionally, it offers increased convenience and decreases errors of measurement.

- No more error resulting from reading Vernier scales
- Brain atlas coordinates may be input into the controller, with no computer required
- Coordinate distances are automatically calculated
- Touch screen controller for easy, intuitive control with better than 10µm precision
- Graphic controller display for instant operational feedback
- Hand controller for complete manual control

Three control modes put the power and accuracy of the **MTM-3** in your hands.

- Manual mode
  - Move the actuator using the touch panel or the intuitive manual 3-axis wheel controller
  - Individual axes may be easily disabled/enabled to ensure motion on only the desired axis
  - Controller allows for three different speed sensitivity levels
- Coordinates mode
  - Specify retracted position
  - Store three origin definitions (references)
  - Probe position may be displayed with respect to any of the references, as well as absolute coordinates
  - Position plot cursor graphically represents the actuator arm position with respect to any of the stored references
  - All functions are accomplished without the use of a computer, and a computer interface is also available, if desired.
- Optional Computer Control
  - Remote computer control through a USB port
  - Text based command set provided
  - Use a terminal program to create simple scripts for repetitive operations

Parts List

After unpacking, verify that there is no visible damage to the equipment. Verify that all items are included:

(1) **MTM-3** Base plate with U frame and motorized AP-axis assembly. An MTM-6 system has two AP-axis assemblies mounted to the U frame.

(1) Motorized DV-ML axes arm with articulating knuckle to connect the control arm to the frame. An MTM-6 system includes two DV-ML arms.

(1) Control box
(1) Hand controller
(1) Power supply for the control box
(1) Mouth adapter
(1) 502204 Rat adapter or (1) 502062 Mouse adapter with toothbar
(1) 502055 Pair of 18° rat ear bars or (1) 502056 Pair of 45° rat ear bars
(1) Probe holder with mounting clamp
(1) Instruction Manual

Unpacking

Upon receipt of this instrument, make a thorough inspection of the contents and check for possible damage. Missing cartons or obvious damage to cartons should be noted on the delivery receipt before signing. Concealed damage should be reported at once to the carrier and an inspection requested. Please read the section entitled "Claims and Returns" on page 39 of this manual. Please contact WPI Customer Service if any parts are missing at 941.371.1003 or customerservice@wpiinc.com.

Returns: Do not return any goods to WPI without obtaining prior approval (RMA # required) and instructions from WPI's Returns Department. Goods returned (unauthorized) by collect freight may be refused. If a return shipment is necessary, use the original container, if possible. If the original container is not available, use a suitable substitute that is rigid and of adequate size. Wrap the instrument in paper or plastic surrounded with at least 100mm (four inches) of shock absorbing material. For further details, please read the section entitled "Claims and Returns" on page 39 of this manual.

INSTRUMENT DESCRIPTION

High resolution stepper motors ensure the accuracy of the **MTM-3** which delivers sub-micron stepping resolution. The **MTM-3** controller (Fig. 3) performs all the necessary calculations and stores the calibration data. No other accessories are necessary to obtain full functionality from the stereotaxic frame. A separate hand controller unit (Fig. 4) is also included as an option for more intuitive and tactile control when operating the manipulators. The hand controller is especially helpful when you are using a microscope for precise placement of probes.

Frame

The three axis frame is configured as illustrated in Fig. 2. The AP and ML axes define the position of the axes in relation to the base plate. The DV axis defines the vertical position of the axes above the base plate.

The axes are color coordinated. The connections on the controller, the labels on the axes and hand controller and the touch panel interface all use this color code.

- AP - (Anterior/Posterior) Red
- DV (Dorsal/Ventral) - Yellow
- ML (Medial/Lateral) - Green

NOTE: The color coded arrows on the axis labels indicate the "positive" direction of the axis.

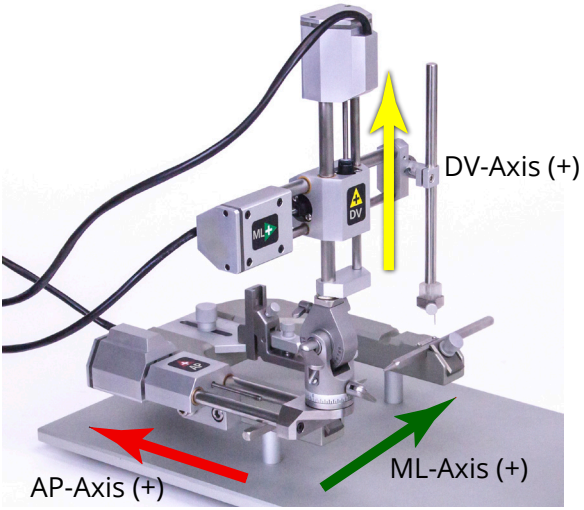


Fig. 2–The "positive" direction of the AP, DV and ML axes is indicated by the color coded arrows on each axis.

Controllers

All the control functions available for the **MTM-3** may be executed from the control box. It has a 5-inch Color LCD touch panel display.

Fig. 3–The controller has a touch screen interface.

The hand controller offers a tactile method for intuitive manual control. It also offers greater control resolution.

Fig. 4–The hand controller is available for use with the **MTM-3**.

Setup

Assembling the Frame

1. The rat adapter assembly (Fig. 5) is shipped mounted upside down on the main frame to prevent damage. Loosen the thumbscrew. Flip the rat adapter assembly right side up, and reinstall the rat adapter (Fig. 6).

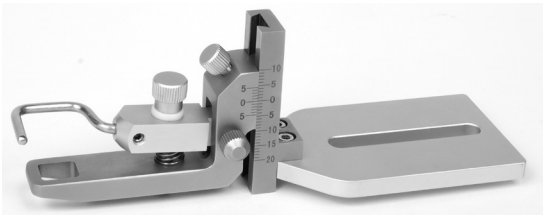


Fig. 5–For shipping, the rat adapter is mounted upside down.

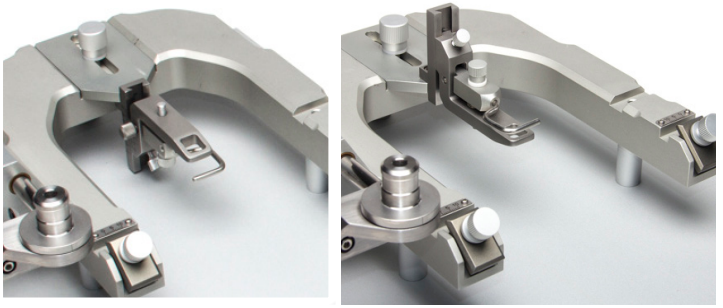


Fig. 6–(Left) Remove the thumbscrew, flip the rat adapter and reinstall the thumbscrew.
Fig. 7–(Right) The rat adapter is properly installed.

2. The manipulator arm is already assembled with the DV and ML axes (Fig. 8). To install the manipulator arm (DV and ML axes), loosen the turret lock handle, so that it does not protrude into the mounting hole (Fig. 9). If the lock is not loosened sufficiently, the turret will not fit over the turret post.

Fig. 8–(Right) The manipulator arm has both the DV and the ML axes.

3. Align the turret with the turret post (Fig. 9), so that the manipulator arm assembly slides down into contact with the base of the turret post. Rotate the turret lock clockwise to secure the manipulator arm (Fig. 10).

   NOTE: The orientation of the manipulator can be adjusted in the horizontal plane. Simply loosen the turret lock handle and rotate the manipulator assembly to the desired orientation. Use the scale on the base of the manipulator assembly to properly align it (Fig. 11). Tighten the turret lock when you are finished.

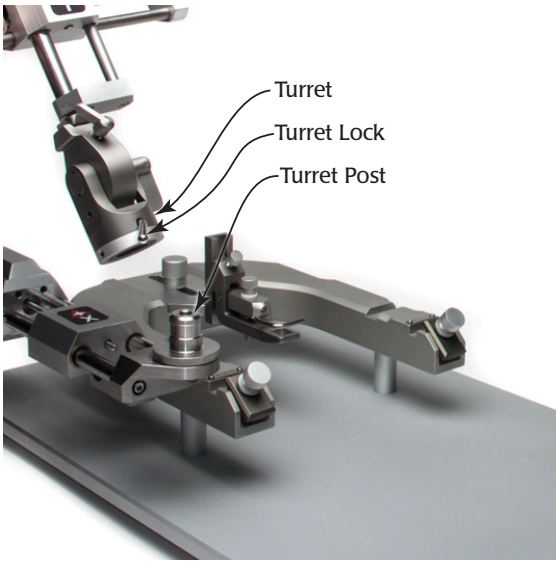


Fig. 9–(Left) Position the turret over the post and slide it into place.
Fig. 10–(Right) Tighten the turret lock.

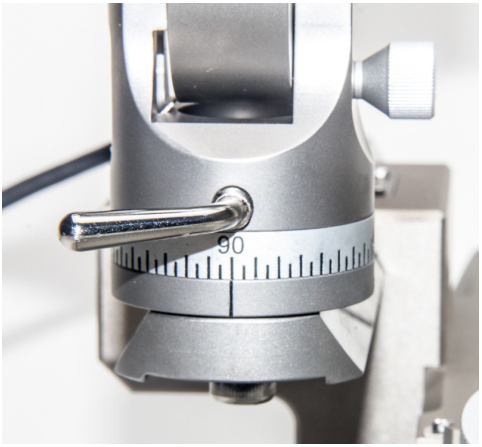


Fig. 11–Line up the scale on the turret with the line on the turret post to properly orient the manipulator assembly in the horizontal plane.

4. The probe holder is provided pre-assembled with a mounting clamp which incorporates a V-shaped fitting that couples directly to the mating ˝V˝ recess on the AP-axis of the manipulator. Align the probe holder with the manipulator and hold it in place (Fig. 12).

5. Align the thumbscrew with the hole. Then, tighten the thumbscrew to secure the probe holder to the manipulator assembly (Fig. 13).

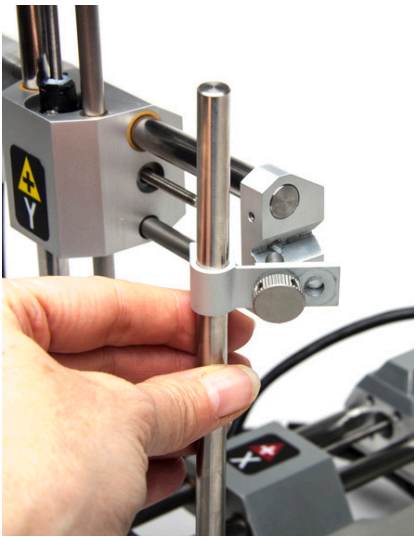


Fig. 12–(Left) Align the probe holder with the V-shaped notch on the manipulator arm.
Fig. 13–(Right) Then, line up the thumbscrew with the screw hole. Secure the probe holder with the thumbscrew.

6. The ear bars mount into the ear bar channels (Fig. 14). Loosen the thumb screws. Slide each ear bar into its slot and gently tighten the thumbscrews enough to secure them without over-tightening them (Fig. 16).

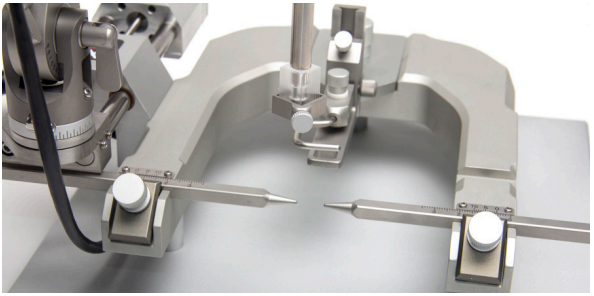


Fig. 14–Slide the ear bar into position and tighten the thumbscrew.

NOTE: The pointed end of the ear bar should face toward the center, and the ear bars should be installed so that the numbers are right side up and the increments on the two vernier scale touch each other.

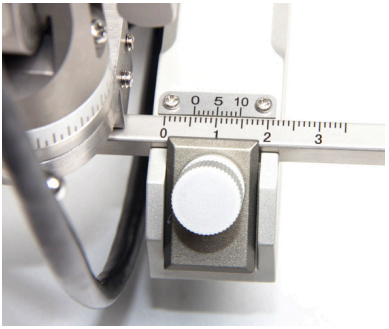


Fig. 15–(Left) Mount the ear bars so the numbers are right side up.
Fig. 16–(Right) Use the thumbscrews to secure the ear bars in place.

7. Spiral cable wrap and a cable clamp are provided. If you wish, you may cut the cable wrap to appropriate lengths and use it to help position your cables as shown in Fig. 19.

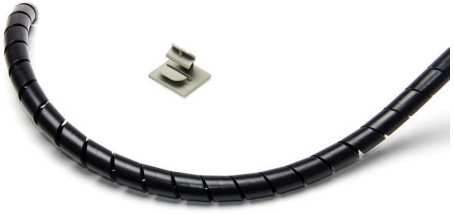


Fig. 17–(Left) A length of spiral cable wrap and an plastic cable clamp are provided.

Fig. 18–(Right) Cut the cable wrap to a desired length and wrap it around your cables to help secure them.

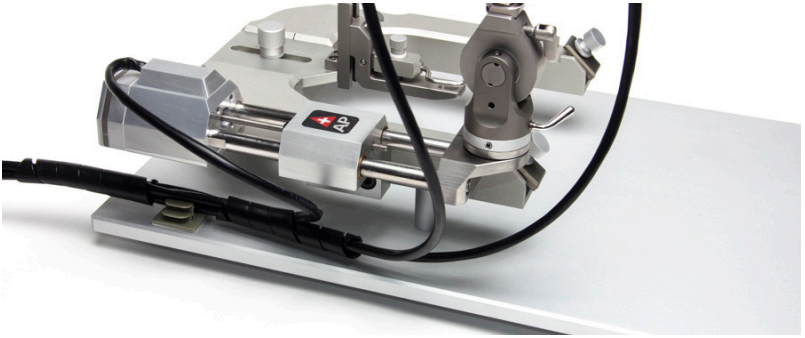
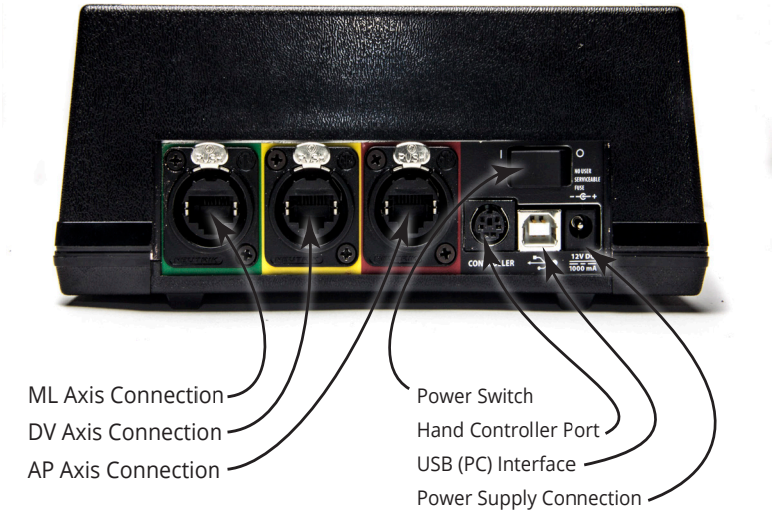


Fig. 19–The cables are secured so that they do not interfere with the travel of any axis.

Making Controller Connections

All the electronic connections are made on the back of the controller.



1. Align the arrow on the ML-axis motor controller cable connector (green) with the top of the ML-axis connection port on the controller. Depress the tab at the top of the connection port and push the connector into the port (Fig. 20). Repeat for the DV-axis (yellow) and AP-axis (red) cables.

Fig. 20–Depress the button, line up the arrow at the top and slide the cable for the axis control into its color-coded port.

2. If you are using the hand controller, line up the cable connector with the Hand Controller Port and push it into place.
3. To use computer control (USB), connect a USB cord from a USB port on the computer to the USB interface port on the controller
4. Plug the power supply cable into the Power Supply Connection port on the controller. Plug the other end into an AC wall outlet.

Fig. 21–This control box is connected to the three axes, the hand controller and the power supply.

Configuring Your System

Before you begin, configure your system.

1. Power up the unit by turning on the power switch on the rear panel of the control box. The splash screen displays.
2. Tap the screen to reveal the Main Menu page.

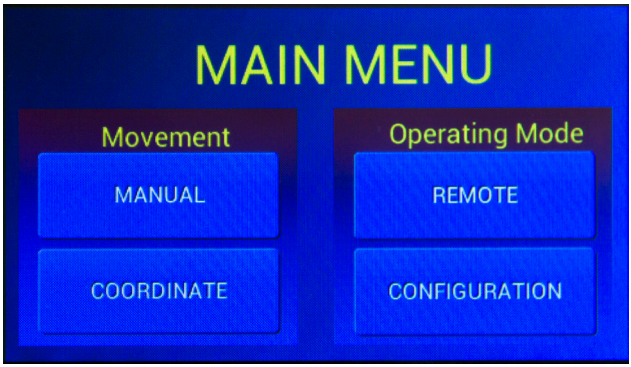


Fig. 22–From the Main Menu, select Configuration.

3. Tap the Configuration button. The Configuration screen appears.

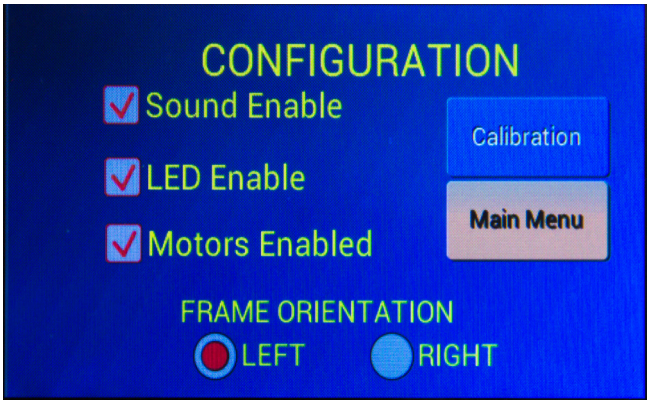


Fig. 23–The Configuration window allows you to enable/disable sound, enable/disable the lights on the axes, enable/disable all the motors, choose a left hand or right hand orientation and calibrate the axes.

4. By default, sound is enabled. When a motor is engaged, you hear an audio cue. If you do not want audio cues, you may touch the **Sound Enable** check box to deselect it.

   When checked, the various feedback sounds used to indicate activities are

enabled. When unchecked, the sounds are muted. These settings are stored and recalled even after you turn the unit off.

5. The **MTM-3** has a blue LED on each axis to indicate which actuator is operating. This is especially useful when operating with very small step sizes, where the actuator motion may be difficult to see. If you prefer, the LEDs may be disabled by touching the **LED Enable** check box to deselect the option.

6. When the axes are properly positioned, you can disable the motors to minimize the electrical noise in the system when sensitive measurements are made. Touch the **Motors Enabled** check box to deselect it. The next time you move the axes, they are automatically re-enabled.

7. The controller can be used to operate a set of axes on the left or the right side of the stereotaxic frame. Select the **Left** or **Right** Frame Orientation radio buttons to set the orientation of the manipulator on the frame. This selection is stored in memory even after you turn the unit off.

   TIP: The axes are oriented left and right looking into the open end of the frame.

8. Press the **Main Menu** button to return to the Main Menu screen.

Calibrating the Motor Positions

Before you use the **MTM-3**, calibrate the motor positions. Calibration defines the limits of movement for each motor in the controller software.

1. On the Main Menu page, touch the **Configuration** button. The Configuration screen appears.

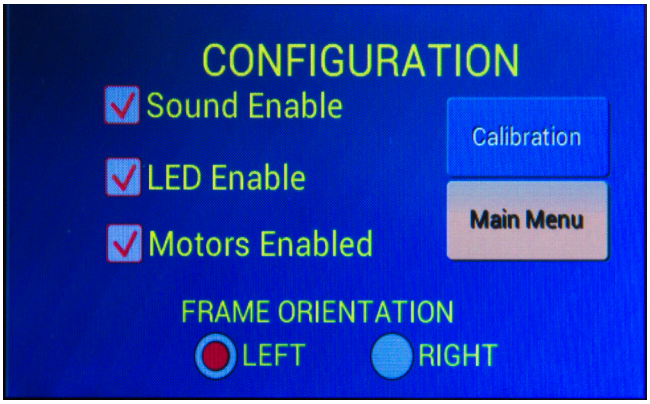


Fig. 24–Press the Calibration button to open the Calibration screen.

2. To calibrate the motor positions, tap the **Calibration** button. The Calibration screen appears (Fig. 25).

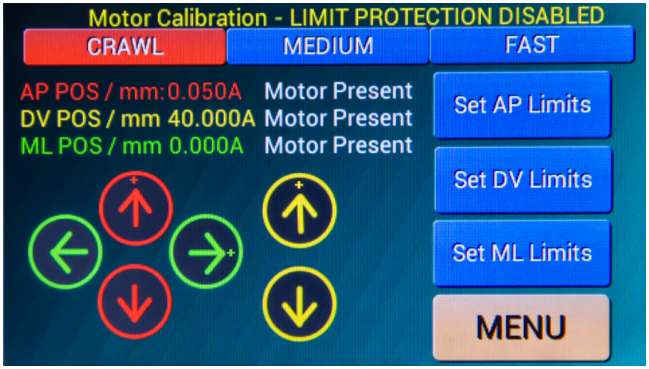


Fig. 25–The Calibration window lets you set motor limits.

The arrows are used to move the three motors. The arrows on the display coordinate with the colors assigned to each axis. AP is red, DV is yellow and ML is green.

Three speeds are available to move the motors. Choose a speed (Crawl, Medium or Fast) by touching the appropriate button (**Crawl**, **Medium** or **Fast**). On power-up, the speed is always set to crawl by default.

3. Press the arrow with the plus sign "+" for the axis you wish to calibrate. Observe the motor being activated. Continue pressing the arrow until the axis runs to the end of its travel. If sound is enabled, the pitch of the motor sound changes when you reach the limit of its travel. This will not damage the motor or the frame.
4. Press the **Set Limit** button for the appropriate axis. This stores the end of travel position. The controller remembers this position and prevents the motor from reaching the end of travel.
5. Repeat the procedure for the remaining axes. Avoid moving the corresponding motors after your press the **Set Limits** button to avoid running into the end of travel again and invalidating the stored values.
6. Press the **Menu** button to return to the Main Menu screen.

OPERATING INSTRUCTIONS

The Main Menu is subdivided in two main types of activities:

- **Movement**–Operate the motorized axes either manually or by entering numerical coordinates
- **Operating mode**–Use these options to configure the system or to enable remote computer control

Before using the system the first time:

- Configure the system. (See “Configuring Your System” on page 11.)
- Calibrate the motor positions. (See “Calibrating the Motor Positions” on page 12.)

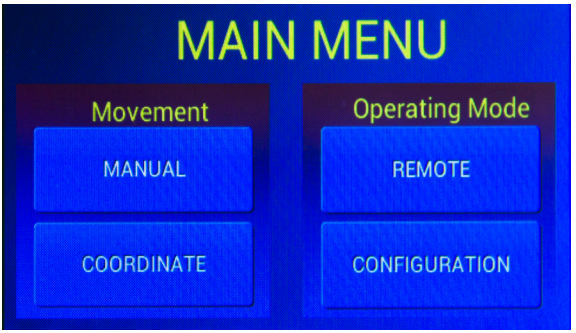


Fig. 26–The Main Menu gives you access to control options and configuration settings.

The **MTM-3** may be controlled manually with the touch screen controller or the hand controller, or it may be operated remotely with a computer using a USB port.

Manual Control

Press the **Manual** button on the Main Menu (Fig. 26) to enter the manual motor control mode.

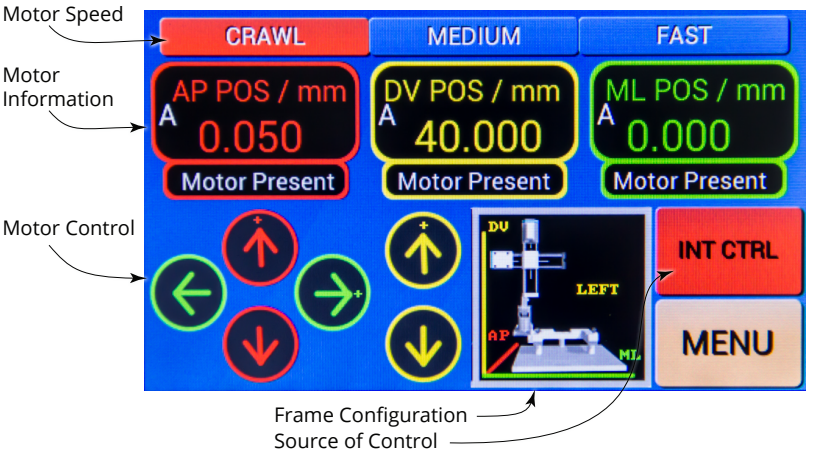


Fig. 27–The Manual Mode control window allows you to control all three axes from the touch screen interface.

Motor Speed–Select the speed for the motor control. By default, the unit always starts in crawl speed. Options include **Crawl**, **Medium** and **Fast**. The motor speed setting affects all motors.

Motor Control–These six arrows can be used to manually control the position of the three axes. The three buttons marked with a + move the axes in a positive direction (Fig. 2).

Frame Configuration– The stereotaxic frame is configured as a right or left hand unit as indicated here. To change the configuration, see "Configuring Your System" on page 11.

Source of Control–Internal control (**INT CTRL**) allows you to use the touch screen arrows to command the motors. If you want to use the hand controller, touch the **INT CTRL** button to toggle to **HAND CTRL**. Touch it again to toggle back to internal control.

Motor Information–This area shows critical information for each axis.

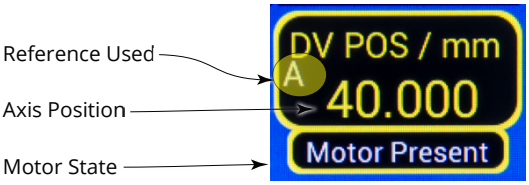


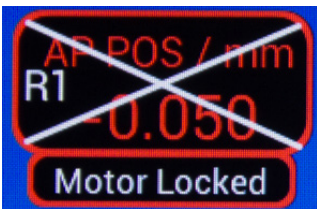
Fig. 28–The Motor Information area provides important information.

Reference Used–This indicates which reference point is in use for determining the probe position. Options include **A** (absolute coordinates), **R1** (reference 1), **R2** (reference 2) and **R3** (reference 3). **R1**, **R2** and **R3** are user defined AP-DV-ML coordinate points. See "Assigning Reference Points" on page 22.

Axis Position–This number indicates the position of the axis in millimeters with respect to the selected reference point (**A**, **R1**, **R2** or **R3**).

Motor State–One of three motor states may appear:

- Motor Present–The motor is connected and enabled.
- Motor Locked–The motor is connected and locked (Fig. 29). When the motor is locked it will not respond to any controls. When you have positioned the probe as desired, you may lock the motors to prevent accidental movement of the axis. Simply tap the Motor Information section to lock (or unlock) a motor.
- Motor Absent–If the motor is disconnected, a white AP appears across the Motor Information area and the status is Motor Absent (Fig. 30). When the motor is reconnected, the indicator returns to the normal state, and the motor operation is re-enabled.



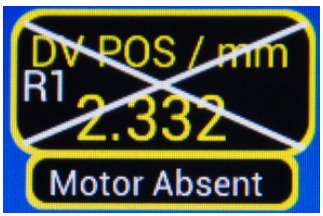


Fig. 29–(Left) When the motor is locked, a white X displays across the Motor Information area, and the motor status becomes Motor Locked.

Fig. 30–(Right) When the motor is not connected, a white X also appears, and the motor status becomes Motor Absent.

Adjusting the Motor Speed

To choose a motor speed for all three axes, press the **Crawl** (0.02mm/s), **Medium** or **Fast** (2.0mm/s) button. The active button is shown in red.

Fig. 31–The speed is set to crawl.

Locking a Motor

To prevent accidental movement, you may lock any (or all) of the axes. Simply touch the Motor Information area for the axis you wish to lock. This disables the axis. If you attempt to use the arrows or the hand controller to move a motor when it is locked, the motor will not move. A chime sounds to indicate that you are attempting to move a locked motor. When the motor is locked, a white X appears across the Motor Information section of the screen and the motor status is Motor Locked (Fig. 29).

Tap the Motor information area again to unlock and re-enable the motor.

Moving the Axes with the Touch Screen Controller

To move any of the axes, press the corresponding arrow on the controller touch screen (Fig. 32). The motor continues to move as long as the arrow is pressed. It stops when you release the arrow button. If sound is enabled, the controller emits a tone to indicate that a motor is attempting to move. At the same time the LEDs on the corresponding axis illuminate when the motor is moving.

Fig. 32–Use the arrows on the keypad to move each of the three axes. AP is red, DV is yellow and ML is green.

NOTE: The buttons with a + indicate movement in the positive direction.

As a safety feature, the vertical (DV) axis is automatically disabled if the DV coordinate is below a user defined value, called the retracted position.

If you attempt to move in the AP-ML plane when the DV axis is below the retracted position, a warning message appears (Fig. 33). Press the **Abort** button to acknowledge the warning and adjust the DV-axis, or press **Proceed** to continue moving in the AP-ML plane. If you press **Proceed**, you will not be warned again while you remain on the this screen. If you navigate away from the Manual Control screen, you will be warned again when you attempt to move the axes without retracting.

Fig. 33–If the present position is below the retracted position, you will get this warning message when you attempt to move the axes in the AP-ML plane.

Using the Hand Controller

To use the hand controller, press the **INT CTRL** button on the screen to change the source of control. The button toggles to **HAND CTRL**, and the motors are then controlled by the external hand controller. When the external hand controller is selected, the arrows disappear (Fig. 34). If the hand controller is not connected, a white X appears over the hand controller (Fig. 35).

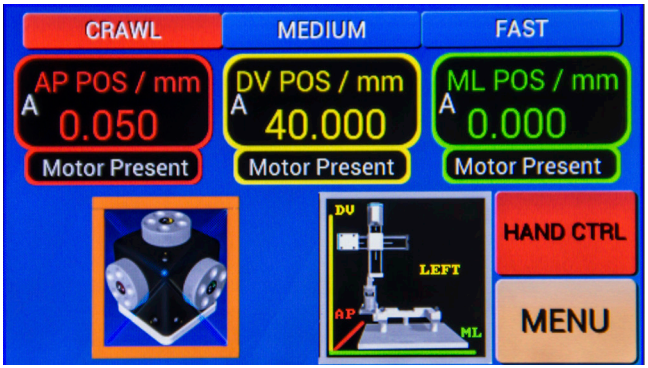


Fig. 34–(Left) When you are using the hand controller, the arrow keys disappear.
Fig. 35–(Right) When the hand controller is not installed, a white X appears over the hand controller on the touch screen.

The controller has a dial and a button for each axis.

- Dials–An arrow on each dial indicates the positive direction (clockwise). You can use the grips on the outside of the dial (Fig. 36) or the finger depressions on the face of the dial (Fig. 37) to rotate the dial in either direction and move the axis.
- Buttons–Each of the three black buttons on the hand controller allows you to quickly toggle through the speed controls and lock the axis. Press the button next to the axis you are moving to toggle between Crawl Speed, Medium Speed, Fast Speed and Lock Axis. An LED on each button is illuminated when the axis is enabled.


Fig. 36–(Left) Rotate the dial for the appropriate axis to move that axis.
Fig. 37–(Right) Use the finger depressions to rotate the dial and move that axis.

Coordinate Navigation

The **MTM-3** coordinate navigation lets you control the movement of the axes by specifying a set of three dimensional coordinates with a resolution of 0.01mm. Each axis (AP, DV and ML) has a 79mm range of movement. The coordinates may be specified in relation to one of three different reference points, or you may use absolute coordinates to control movement.

NOTE: When the **MTM-3** controller navigates between coordinates, it always starts at the user-defined, fully retracted position. When you define your retracted position, set it on the DV axis high enough that any probe or accessory will not contact any surface as it moves in the AP-ML lateral plane at this retracted height.

Absolute coordinates do not change and are tied to the mechanical limits of the frame. That means that 0.00 is the minimum distance of travel on a specific axis and is the closest the frame gets to the lower mechanical stop on that axis. Likewise, 79.00 is the maximum distance of travel on an axis and the closest to the high mechanical stop point. Absolute coordinates are always positive.

Referenced coordinates establish the distance to one of three reference points. A reference is defined using the absolute coordinate system. Then, the reference coordinates become 0.00, 0.00, 0.00 (AP, DV, ML), and the present position is then defined in relation to the reference coordinate.

To use coordinate navigation, press the **Coordinate** button on the Main Menu. The Coordinate Navigation and Presets screen appears (Fig. 38).

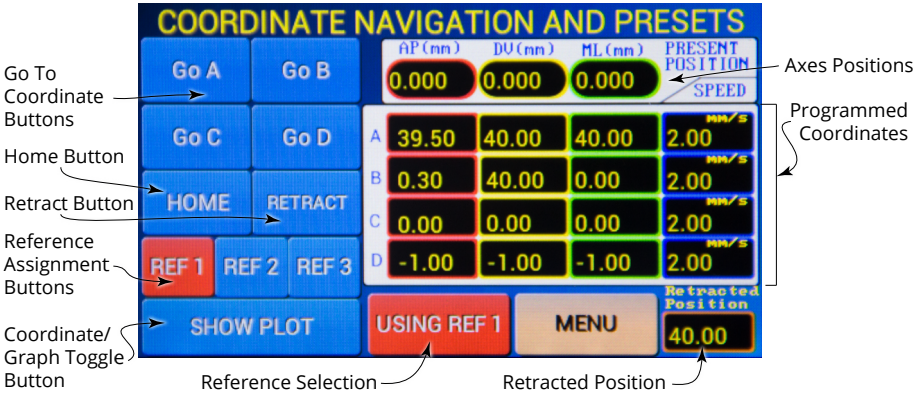


Fig. 38–The Coordinate Navigation and Presets screen lets you program reference points and preset locations.

Go To Coordinate Buttons–Four coordinates may be user defined. After defining your coordinate positions, press one of these **Go To** buttons to command the motors to the move to the designated position.

In the example above, when you press the **Go D** button, the motors retract to 50mm above Ref 1 on the DV axis. And, then they travel to the coordinate position (40.00, 0.50, 60.00). These coordinates use reference 1 as the starting position.

Home Button–This button commands the motors to move to the place farthest from the center of the frame where most experiments are performed. The axes will move to the following absolute coordinates:

	Left Hand	Right Hand	
AP	79mm	80mm	Maximum forward
DV	79mm	80mm	Top
ML	0mm	80mm	Closest to edge of frame

Retract Button–This button commands the DV motor to move to its retracted pos

Reference Assignment Buttons–Used these three buttons (**REF 1**, **REF 2** and **REF 3**) to define your three reference points. Press an **REF** button to assign the Present Position to that reference point. This overwrites any previously stored reference point. See "Assigning Reference Points" on page 22.

Coordinate/Graph Toggle Button–Touch the **Show Plot** button to see a graphical representation of the motor positions. Touch the plot to return to the previous display. See "Understanding the Plot" on page 20.

Reference Selection– Use this button to select one of your previously defined reference points or to select the Absolute Coordinate control. When absolute coordinates are used, this button says **Absolute**. When pressed again, the button toggles through the three Reference points (**Using Ref 1**, **Using Ref 2**, **Using Ref 3**). When a reference point is selected, the corresponding Reference Assignment Button turns green.

NOTE: When a reference point in use is changed, the present position AP, DV and ML coordinates change to indicate the distance of the present position to the new reference point.

Retracted Position–This is the position in mm above the reference DV coordinate point that the probe retracts before any lateral movement occurs. See "Setting the Retracted Position" on page 21.

Axes Positions–These are the coordinates of the current position of each axis in relation to the selected reference point.

Programmed Coordinates–The coordinates on this table define four programmed locations and the final approach speeds for each coordinate. When you press a **Go To Coordinate** button, the DV-axis moves to the programmed coordinates at the rate of speed defined in this section. See "Defining Programmed Coordinates" on page 22.

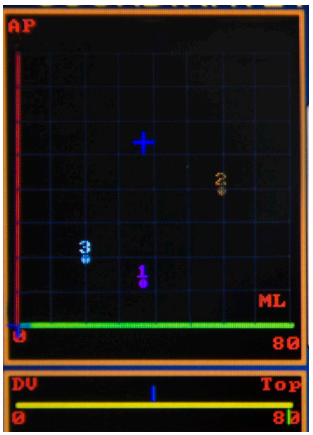
Understanding the Plot

The **MTM-3** displays a plot showing the three references, the retracted position and the current position. When the motors are commanded to change position in the Coordinate Navigation Mode, the plot appears and the blue cursor shows the real time position.

The plot is a graphical representation of what's happening on the stereotaxic frame. The upper portion of the graph represents the AP-ML plane (parallel to the base plate), and the DV axis (vertical height) is represented along the bottom section of the plot.

- The blue plus sign (+) indicates the present position of the axes.
- The three colored numbers indicate the three reference positions.
- The blue line on the DV axis indicates the present position of the axis.
- The green line under the DV axis indicates the location of the retracted position. It depicts the retracted position with respect to the DV range of motion given the reference in use.

NOTE: When you change the reference, the indicator changes to show the new location of the retracted position for the reference in use.



+ Present Position on AP-ML Plane

1 Reference Point 1

2 Reference Point 2

3 Reference Point 3

Present Position on DV Axis

Retracted Position on DV Axis

Fig. 39–The blue + is a graphical representation on the plot of the present position of the axes.

Setting the Retracted Position

The retracted position is the position in mm above the reference point that the probe retracts before any lateral movement occurs. Whenever you program a movement, the probe always moves along the DV axis first to raise the probe above the working area. To change the retracted position:

1. Tap the **Retraction Position** on the touch screen. Then, the retracted position is set to 0.00 and the keypad appears (Fig. 40).

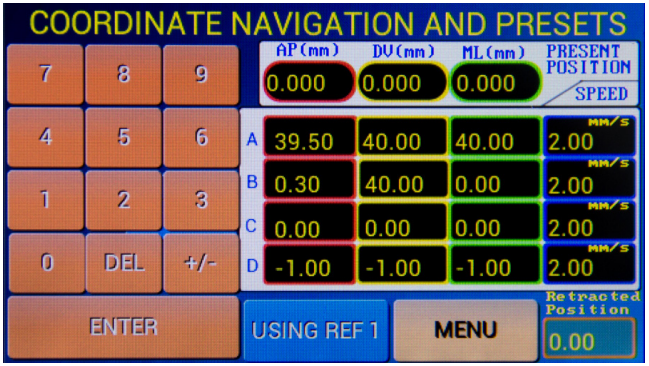


Fig. 40–The keypad appears and the retracted position becomes zero.

2. Enter the desired coordinate. The interface assumes two decimal places. So, for a value of 20.00, enter "2000."
3. Press Enter to store the new value.

Selecting a Reference Point

Press the **Reference Selection** button to toggle through the following four options:

- Absolute
- Using Reference 1
- Using Reference 2
- Using Reference 3

When you select a reference point, the corresponding **Reference Assignment** button turns green.

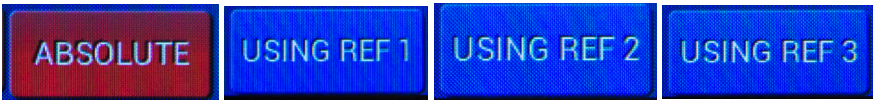


Fig. 41–Press the Reference Selection button to select your reference point. These are the four options.

Assigning Reference Points

To assign a new set of coordinates to a reference position:

1. Move the axes to the desired position.
2. Select a **Reference Assignment** button. For example, to assign a new set of coordinates to Reference 3, press the **REF 3** button. A warning displays to indicate that you are actually changing the physical location referred to by this reference point.

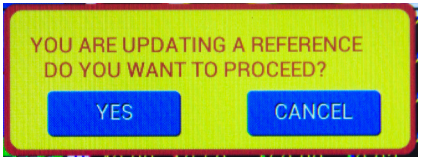


Fig. 42–A warning displays when you attempt to update a reference point.

3. Press **Yes** to update the reference or **Cancel** to abort the update process. When you press **Yes**, the present position of the axes becomes the new reference point.
   - The **Reference Assignment** button turns RED, indicating that it was recently updated.
   - The displayed coordinates change to 0.00, 0.00, 0.00, indicating that the distance of the present position from the reference point is 0.00mm on all axes.

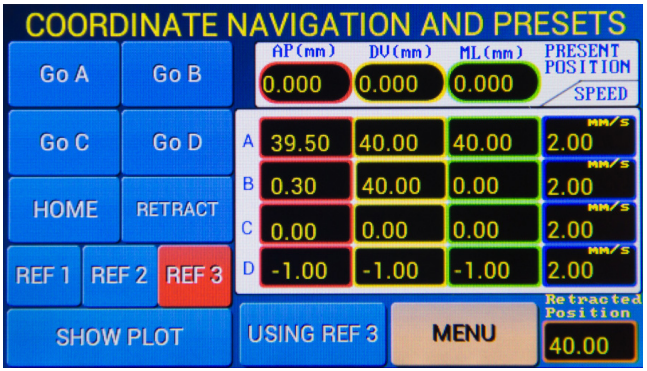


Fig. 43–The present position is set to 0,0,0, and the Ref3 button turns red to indicate that it was just updated.

Defining Programmed Coordinates

The **MTM-3** can store four sets of three dimensional coordinates for navigation (A, B, C and D). Each set has AP, DV and ML coordinates, as well as final approach speed.

1. To update a parameter, touch the value on the screen. This clears the current entry, highlights the square and brings up the coordinate entry keypad.

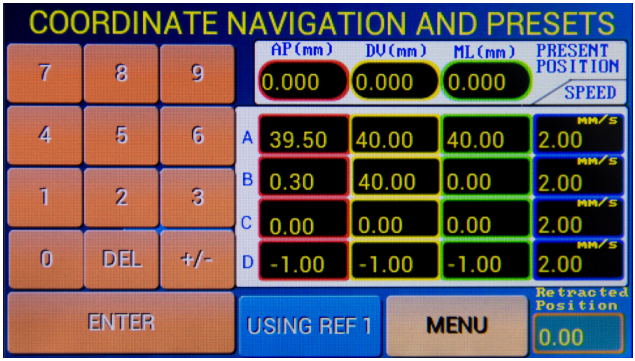


Fig. 44–The AP coordinate of programmed position A is highlighted, and using the keypad, it was set to 20.00.

2. The keypad allows you to enter the speed and coordinates down to a resolution of 0.01mm. As you press the keypad keys, the parameter is updated.
   - Do not enter a decimal point. The **MTM-3** assumes two decimal places. If you want to enter 20.00, enter 2000.
   - The **+/–** key inverts the sign of the entry.
   - **DEL** clears the entry.
3. Press **Enter**. Once the value is entered, the parameter's background color returns to black and the keypad is hidden. The value entered is stored memory, even when the unit is powered off.

Point to Point Coordinate Navigation

Once your programmed coordinates are defined, you may use them to navigate using the **Go To Coordinate** buttons.

CAUTION: Remember when you are using the programmed coordinates, the **MTM-3** navigates to the location based on the current reference point used. Choosing a different reference point results in a different spatial location.

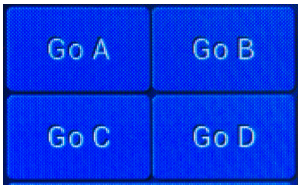


Fig. 45–The four Go To Coordinate buttons may be used to navigate to the four programmed coordinate locations.

To navigate to a set of programmed coordinates, press the appropriate **Go To Coordinate** button. As soon as you press one of the four **Go To Coordinate** buttons,

the navigational graph appears in place of the buttons and the following sequence begins:

1. DV axis travels to the retracted position at maximum speed (2mm/s).
2. AP axis travels to the programmed AP coordinate (using the selected reference point as the starting position) at maximum speed (2mm/s).
3. ML axis travels to the programmed ML coordinate (using the selected reference point as the starting position) at maximum speed (2mm/s).
4. DV axis travels to the programmed DV coordinate (using the selected reference point as the starting position) at the programmed final approach speed.

NOTE: A small "Last Visited" Indicator is drawn over the letter of the programmed coordinates just visited (Fig. 46).

Fig. 46–The highlighted letter indicates the programmed coordinates that were used last.

NOTE: If you command the axes to move to coordinates beyond the mechanical limits of the frame, the MTM-3 attempts to move to the coordinates. If it reaches the end of travel on any axis, it moves the other axes as defined. Then, a warning message displays indicating which axis (or axes) was not able to fulfill the command (Fig. 47).

Fig. 47–A warning displays when you command the MTM-3 to move to coordinates outside the range of travel of any axis.

Emergency Stop

You may abort the movement of the axes at any point in a navigation sequence by simply touching the screen anywhere. If you touch the screen during a navigational sequence, a message displays for a few seconds (Fig. 48). Then, the display returns to normal operation while the motors idle at the position where they were halted.

Fig. 48–A message appears if you touch the screen anywhere during a navigational sequence.

Remote Control

The **MTM-3** can be operated remotely from a host computer interfaced through a USB port. A set of serial commands allows the host system to easily perform sequences accurately and with great repeatability. This allows you to automate repetitive tasks with minimum effort. For specific information on programming remote control, see "Appendix A: Remote Control Programming" on page 31.

NOTE: The use of remote computer control requires a terminal program like RealTerm.

When you are using remote control, the **MTM-3** receives successive commands and places them in a command queue. As each command is executed, the next command in the queue is processed until all pending commands have completed. Any new commands are placed in the next available position in the buffer. When the end of the buffer is reached, new commands are written to the beginning of the buffer. This is referred to as a circular buffer. If a **Loop** command is executed, the sequence repeats from the beginning. The **MTM-3** has a buffer capable of storing and processing up to 100 commands.

To enter the remote operation mode press the **Remote** button from the Main Menu. The Remote Operation screen appears (Fig. 49). The Remote Operation screen displays the present AP, DV and ML coordinates, the buffer position, last command position and the command being processed.

NOTE: The **MTM-3** will not process any remote commands unless it is in the remote mode.

Emergency Stop

To abort any command sequence in progress, touch the screen anywhere. If you touch the screen during a command sequence, all the commands in the queue are erased, and all three motors stop. The motors idle at the position where they were halted.

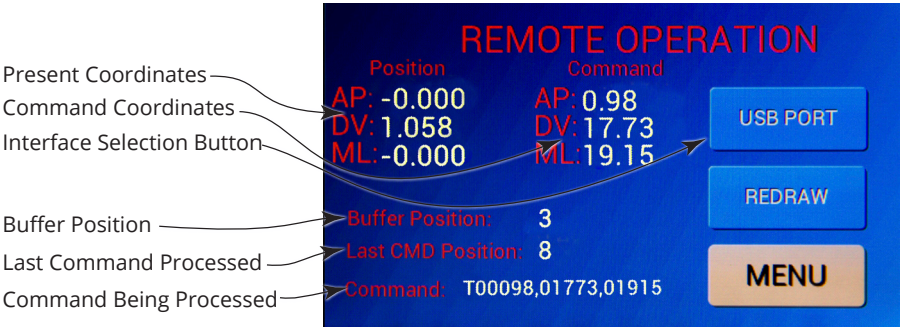


Fig. 49–The Remote Operation screen appears when you press the Remote button on the Main Menu.

Present Coordinates–These AP, DV, ML coordinates designate the present position of the axes.

Command Coordinates–These AP, DV, ML coordinates define the target position where the axes are traveling.

Interface Selection Button–This button indicates the active computer interface. Touch this button to toggle between USB and Bluetooth (for future use).

Buffer Position–This numeral indicates the position that the command being executed occupies in the command queue. In the example above, the program is working on step 3.

Last Command Position–This numeral indicates the position in the queue of the last command received. In the example above, the last command received was step 8.

Command Being Processed–This text string is the command being executed. In the example, the MTM-3 is traveling to a set of coordinates.

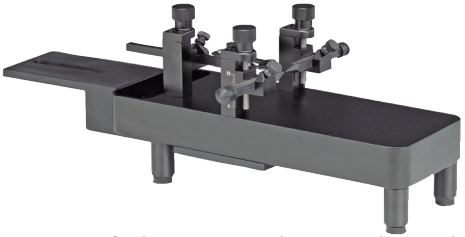
Redraw–Press this button to update the screen.

ACCESSORIES

Adaptors

502063 Mouse and Neonatal Rat Adaptor
502213 Platform, Gas Anesthesia, with mouse Mask (use with 502063)
502062 Mouse Adaptor
502204 Rat Adaptor with a pair of ear bars, 18°
502226 Cat/Monkey Adaptor for 502600 series
502238 Spinal Adaptor for Rat
502060 Guinea Pig Adaptor for 502600 series
502241 Dog/Monkey Adaptor for Parallel Rail Stereotaxic instruments, with a pair of ear bars, 18°

The WPI Mouse and Neonatal Rat Adaptor (**502063**) employs light, Delrin® adjustable ear bars with tapered points on one end and non-invasive points on the other to facilitate surgery on mice and rat pups. Adjustable ear bars may be independently adjusted in height to the level the skull. Laser engraved scales show the vertical positions of the ear bars. A tooth bar and nose clamp secures the nose. A well in the thick aluminum body may be filled with dry ice and alcohol for hypothermic anesthesia of neonatal animals. The adaptor clamps securely in the center of the "U" frame of the stereotaxic instrument. When gas anesthesia is needed, a gas mask (**502213**) may be mounted on the adaptor.



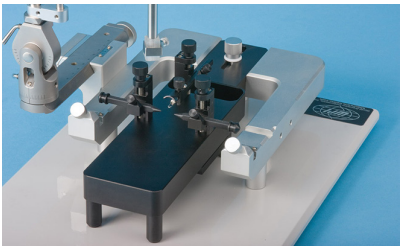
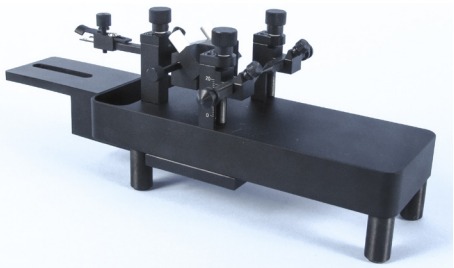


Fig. 50–(Left)The Mouse and Neonatal Rat Adapter (502063).
Fig. 51–(Right) Image shows the 502063 mounted on a standard stereotaxic frame (502600).



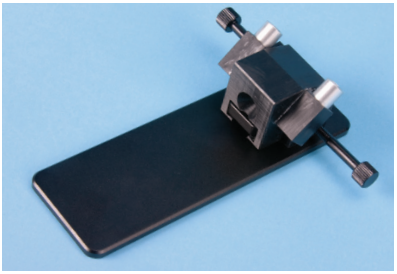
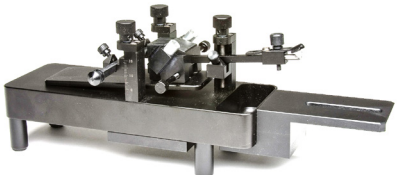


Fig. 52–(Left) Gas mask (502053) is shown mounted on the mouse and neonatal rat adaptor (502063).
Fig. 53–(Right) The Gas Anesthesia Platform (502213) can be mounted on the neonatal rat adapter.



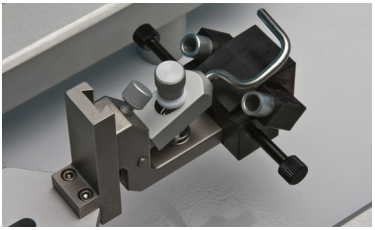


Fig. 54–(Left) 502213 gas anesthesia platform mask is shown mounted on the 502063 mouse/neonatal rat adaptor for the 502600.
Fig. 55–(Right) *502054 Gas mask attached to the standard stereotaxic frame rat adaptor (502204).*

Probe Holders

502210 Probe Holder with corner clamp, 0.3-1.5mm opening
502067 Probe Holder with side clamp, 0.3-3.5mm opening
502070 Cannula Holder, opens to 3.4mm
502068 Large Probe Holder, 6.5-13mm opening
502237 Extra Large Holder for OmniDrill35 Microdrill
502236 Microdialysis Probe Holder, 1.5mm hole
502244 Micrometer Adjustable Electrode Holder, 10µ resolution, 25mm travel, 0.3-1.5mm opening
502245 Manual Microsyringe Injection Holder, 10µ resolution, 25mm travel

Fig. 56–The Manual Microsyringe Injection Holder (502245) can be mounted on any stereotaxic frame.

Fig. 57–(Left) Cannula Holder (502070)
Fig. 58–(Center Left) Large Probe Holder (502068)
Fig. 59–(Center Right) Micrometer Adjustable Electrode Holder (502244)
Fig. 60–(Right) Extra large Holder for the OmniDrill 35 Microdrill (502237). The drill is not included with the probe holder.

Ear Bars

502055 Ear Bars, Rat, 18°, (pair)
502056 Ear Bars, Rat, 45°, (pair)
502224 Ear Bars, Cat, 18°, (pair)

502225 Ear Bars, Cat, 45º, (pair)
502235 Ear Bars, Mouse, 60º. Non-rupture, (pair)
502242 Ear Bars, Rat, Hollow. 1.5mm hole for auditory stimulation

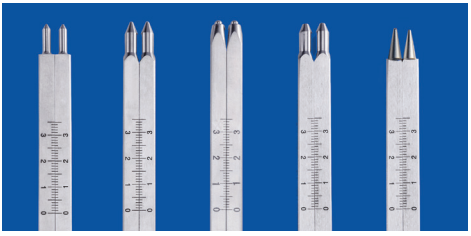


Fig. 61–Ear bars from left to right–502235, 502056, 502225, 502242, 502055.

Other Accessories

502053 Mask, Gas Anesthesia, Mouse
502054 Mask, Gas Anesthesia, Rat
502201 V-Clamp, 10/32 screw
502213 Platform, Gas Anesthesia, with mouse Mask (use with 502063)
502243 Adjustable Stage Platform for 502600 series, 2cm high
503598 Micro-Drill, 35K RMP, 110/220VAC, w/ a set of bits
503599 Micro-Drill, 35K RMP, 240VAC, w/ a set of bits
503567 Heating Plate for 502063, 4X15cm, 5mm thick (use with ATC2000)

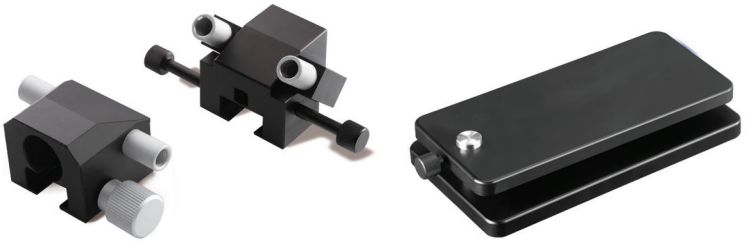


Fig. 62–(Left) The gas mask on the left is for a rat (502054), and the one on the right is for a mouse (502053).
Fig. 63–(Right) The Adjustable Stage Platform (502243) can be used with the 502600 series stereotaxic frames to raise the platform 2cm.

TROUBLESHOOTING

Issue	Possible Cause	Solution
Axis will not move	You are attempting to move below the retracted position.	Press Proceed on the control box warning message, or change the retracted position.
	Improper connection.	Re-install the axis connector on the back of the control box. See “Making Controller Connections” on page 9.
	Speed is too slow (Crawl) and the axis appears to remain stationary.	Change the speed to Medium or Fast. See “Adjusting the Motor Speed” on page 16.
Axis will not reach desired position	Axis lost the end of travel position.	Recalibrate the axis. See “Calibrating the Motor Positions” on page 12.
	Cables are in the wrong positions.	Re-install the axis control cables on the back of the control box. Pay attention to the color codes to make sure that each cable is in the correct port. See “Making Controller Connections” on page 9.Then, recalibrate the axes. See “Calibrating the Motor Positions” on page 12.
Cannot communicate with the unit	The unit is in the wrong mode	Place the unit in Remote mode. See “Remote Control” on page 25.
	Wrong COM port settings	Set the computer port to 9600 baud, no parity, 1 stop bit.
	USB cable is not connected	Connect the USB cable from a USB port on the computer to the USB port on the back of the control box.
	Drivers are not installed on the host PC	Download and insta.l the VCP drivers from www. FTDICHIP.com/drivers/VCP.htm.

NOTE: If you have a problem/issue with that falls outside the definitions of this troubleshooting section, contact the WPI Technical Support team at 941.371.1003 or technicalsupport@wpiinc.com.

SPECIFICATIONS

This unit conforms to the following specifications:

Travel .....80mm on each axis

Precision 10µm

APPENDIX A: REMOTE CONTROL PROGRAMMING

Rules for Command Sequences

The USB port is configured as a virtual communications port with the following settings:

- Baud Rate: 9600
- Parity: None
- Stop Bits: 1

The command set used to perform all tasks starts with one letter and may or may not have additional parameters. All commands are in uppercase letters. Upon successful completion of a command the **MTM-3** returns an asterisk character (*). If the command encounters problems or there are syntax errors in the command, the **MTM-3** returns an exclamation point (!).

NOTE: When a remote sequence is running, it may be aborted by touching the screen at any point in the sequence. This stops all the motors and erases all the commands in the queue. In addition, the command buffer position is set to the start of the buffer.

Command Set Overview

Command	Syntax	Parameters	Example	Response
Travel	TAAAAA,DDDDD, MMMMM<CR><LF>	AAAAA-AP coordinate DDDDD-DV coordinate MMMMM- ML coordinate	T-1087,04502,01240 <CR><LF>	*
Move	MAAAAA,DDDDD,MMMMM <CR><LF>	AAAAA-AP coordinate DDDDD-DV coordinate MMMMM- ML coordinate	M–1087,04502,01240 <CR><LF>	*
Move X	XAAAAA<CR><LF>	AAAAA–AP coordinate	X–1087<CR><LF>	*
Move Y	YDDDDD<CR><LF>	DDDDD–DV coordinate	Y–1087<CR><LF>	*
Move Z	ZMMMMM<CR><LF>	MMMMM–ML coordinate	Z–1087<CR><LF>	*
Pause	PTTTT<CR><LF>	TTTTT - Pause time (s)	P0350<CR><LF>	*
Beep	BTTTT<CR><LF>	TTTTT - Beep time (s)	B0102<CR><LF>	*
Loop	LTT<CR><LF>	TT - Repeat times	L10<CR><LF>	Previous responses
Report	R<CR><LF>	none	R<CR><LF>	–2.267,20.194,33.848 *
Stop	S<CR><LF>	none	S<CR><LF>	*
Verbose	VX<CR><LF>	1 = Activate 0 = Deactivate	V1<CR><LF>	VERBOSE=ON *
Reference	G<CR><LF>	None	G<CR><LF>	47.941,59.861,28.586 *
Absolute Coordinates	A<CR><LF>	None	A<CR><LF>	**0.145,45.368,28.586 ***
Retracted Position	QDDDDD<CR><LF>	DDDDD - DV coordinate	Q1127<CR><LF>	*
Set Speed	DSSS<CR><LF>	SSS-Speed	D100<CR><LF>	*

NOTE: Five places are allowed when entering position coordinates. The first place indicates a negative or positive direction. Use a "–" for a negative number or a "0" for a positive number.

NOTE: *When entering position data, the decimal point is implied. For example, 12.46mm is written as 1246. Likewise, –1.02mm is entered as –0102.

Positioning Command Set

Travel

The Travel command tells the motors to navigate to the coordinates provided. Before any travel, the DV axis always moves to the retracted position. (See "Setting the Retracted Position" on page 21.) The command should take the following format: TAAAAA,DDDDD,MMMMM<CR><LF>

In this command statement:

- AAAAA divided by 100 is the AP coordinate in mm
- DDDDD divided by 100 is the DV coordinate in mm
- MMMMM divided by 100 is the ML coordinate in mm
- <CR><LF> is a carriage return and line feed. This executes the command line and places a blank line in the script.

If you want to command the **MTM-3** to travel to the coordinates

- AP = –10.87mm
- DV = 45.02mm
- ML=–12.40

enter the command: T-1087,04502,01240
To indicate that the command was received, you will see: *

Move

The Move command tells the motors to navigate to the coordinates provided. The retracted position is ignored. The AP axis moves first, then the DV and finally the ML. The command should take the following format: MAAAA,DDDD,MMMM <CR><LF>

In this command statement:

- AAAAA divided by 100 is the AP coordinate in mm
- DDDDD divided by 100 is the DV coordinate in mm
- MMMMM divided by 100 is the ML coordinate in mm
- <CR><LF> is a carriage return and line feed. This executes the command line and places a blank line in the script.

If you want to command the **MTM-3** to move to the coordinates

- AP = –10.87mm
- DV = 45.02mm
- ML = –12.40

then, enter the command: M–1087,04502,01240
To indicate that the command was received, you see: *

Move X (Move Y or Move Z)

The Move X (Y or Z) command tells only a single axis (AP, DV or ML) to move. The other two axes remain stationary. The command should take the following format: XAAAAA<CR><LF>

In this command statement, AAAAA divided by 100 is the AP coordinate in millimeters. The decimal point is implied. For example, 12.46mm is entered as 1246. Likewise, –1.02mm is entered as –0102. <CR><LF> is a carriage return and line feed. This

executes the command line and places a blank line in the script.

If you want to command the **MTM-3** to move the AP axis to the –10.87mm position, enter the command: X–1087
To indicate that the command was received, you will see: *

NOTE: To command the DV axis to move use the format YDDDDD<CR>, and to command the ML axis to move, use the format ZMMMMM<CR>.

Script Flow and Information Command Set

Pause

The Pause command pauses the script for the indicated time in seconds. The command should take the following format: PTTTT<CR><LF>

In this command statement, TTTT divided by 100 is the pause time in seconds. The decimal point is implied. For example, 1.02 seconds is entered as 0102. <CR><LF> is a carriage return and line feed. This executes the command line and places a blank line in the script.

If you want to command the **MTM-3** to pause the script for 3.5 seconds, enter the command: P0350<CR><LF>
In response, a 3.5 second delay is inserted before execution of the next command. To indicate that the command was received, you will see: *

Beep

The Beep command causes a tone to sound for the indicated period of time in seconds. The command should take the following format: BTTTT<CR><LF>

In this command statement, TTTT divided by 100 is the beep time in seconds. The decimal point is implied. For example, 1.02 seconds is entered as 0102. <CR><LF> is a carriage return and line feed. This executes the command line and places a blank line in the script.

If you want to command the **MTM-3** to beep for 1.02 seconds, enter the command: B0102<CR><LF>
In response, you will hear a 1.02 second beep. Then, to indicate that the command was received, you will see printed on the screen: *

Loop

The Loop command causes the script to go back to the beginning of the command sequence. The command sequence runs again from the beginning. This cycle is repeated for the number or iterations specified by the command parameters. This command should take the following format: LTT<CR><LF>

In this command statement, TT is the number of times that the loop command repeats the sequence of commands from the beginning of the command queue to the Loop command.

If you want to loop the previous commands 10 times, enter the command:
L10<CR><LF>
To indicate that the command was received, you see the responses for all the previous commands repeated 10 times.

Report

The Report command exports the AP, DV and ML coordinates of the present position. The command should take the following format: R<CR><LF>

<CR><LF> is a carriage return and line feed. This executes the command line and places a blank line in the script.

If you want to command the **MTM-3** to report the present position, enter the command: R<CR><LF>
To indicate that the command was received, you see: –2.267,20.194,33.848
*

The response means that the command was successful (*), and the coordinates of the present position are (AP: –2.267, DV: 20.194, ML: 33.848).

Stop

The Stop command stops the movement on all three axes, clears the command buffer and sets the buffer pointer to the first location on the buffer. The command should take the following format: S<CR><LF>

No parameters are needed. <CR><LF> is a carriage return and line feed. This executes the command line and places a blank line in the script.

To indicate that the command was received, you see: *

Absolute Coordinates

The Absolute command sets the present coordinate system to use Absolute coordinates. The command should take the following format: A<CR><LF>

No parameters are needed. <CR><LF> is a carriage return and line feed. This executes the command line and places a blank line in the script.

To indicate that the command was received, you see: *

Set Verbose Mode

The Set Verbose Mode command activates (or deactivates) the verbose mode. In verbose mode the **MTM-3** Controller reports the actual position as it moves until it reaches the desired position. The command should take the following format: VX<CR><LF>

In this command statement, AP is set to 1 (activate verbose mode) or 0 (deactivate verbose mode). <CR><LF> is a carriage return and line feed. This executes the command line and places a blank line in the script.

If you want to enable the verbose mode, enter the command: V1<CR><LF>
In response, you see: VERBOSE=ON

*

If you want to disable the verbose mode, enter the command: V0<CR><LF>
To indicate that the command was received, you see: VERBOSE=OFF

*

If you enable the verbose mode and command the AP axis to travel from 0.00 to 5.00 (X0500<CR><LF>), then the display looks similar to Fig. 64.

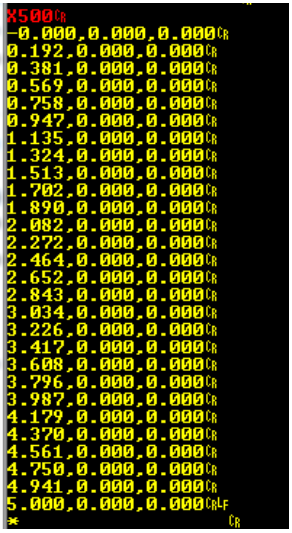


Fig. 64–The verbose mode provides a running dialog of the travel coordinates

Framework Command Set

Set Reference

The Set Reference command defines the present position as the new zero point on all three axes and sets the unit to the reference coordinate system. The program responds with the present position in absolute coordinates. The command should take the following format: G<CR><LF>

No parameters are needed. <CR><LF> is a carriage return and line feed. This executes the command line and places a blank line in the script. When you enter the command to set the present position as new zero reference, an example response is:

47.941,59.861,28.586
*

If we ran a query for the present position using the R command (R<CR><LF>) after executing the G command, the response would be:

0.000,0.000,0.000
*

Use Absolute Coordinates

The Use Absolute Coordinates command sets the coordinate system in use to the Absolute coordinate system. The command responds with the coordinates in the coordinate system in use before switching to absolute coordinates. The command should take the following format: A<CR><LF>

No parameters are needed. <CR><LF> is a carriage return and line feed. This executes the command line and places a blank line in the script. When you enter the unit to use the absolute coordinate system, the response returned looks similar to:

0.145,45.368,28.586
*

The coordinates displayed are the absolute coordinates of the present position (0.145, 45.368, 28.586).

Set Retracted Position

The Set Retracted Position command defines the position on DV axis that is considered the retracted position. The command should take the following format: QDDDDD<CR><LF>

In this command statement, DDDDD divided by 100 is the DV coordinate in millimeters. The decimal point is implied. For example, 12.46mm is written as 1246. Likewise, –1.02mm is –0102. <CR><LF> is a carriage return and line feed. This executes the command line and places a blank line in the script.

If you want to set the retracted position to DV=11.27mm, the command you enter is :
Q01127<CR><LF>

To indicate that the command was received, you see: *

Set Speed

The Set Speed command defines the speed of travel for the axes. The maximum speed is 2.00mm/s, and the minimum speed is 0.02mm/s. The command should take the following format: DSSS<CR><LF>

In this command statement, SSS divided by 100 is the speed in mm/s. The decimal point is implied. For example, 2.00mm/s is entered as D200 and 0.02mm/s is entered as D002. <CR><LF> is a carriage return and line feed. This executes the command line and places a blank line in the script.

If you want to set the travel speed to 0.02 mm/s, enter the command:
D002<CR><LF>
To indicate that the command was received, you will see: *

DECLARATION OF CONFORMITY

WORLD PRECISION INSTRUMENTS, INC.
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DECLARATION OF CONFORMITY

We: World Precision Instruments, Inc.
175 Sarasota Center Boulevard
Sarasota, FL 34240-9258 USA

As the **manufacture/distributor** of the apparatus listed, declare under sole responsibility that the product(s):

MTM-3, MTM-3R, MTM-3BT, MTM-6, MTM-6BT
ANY STEREOTAXIC UPGRADE THAT CREATES A MODEL ABOVE

To which this declaration relates is/are in conformity with the following standards or other normative documents:

Safety:
EN 61010-1:2010
EMC:
EN 61326-1:2013
EN 61326-2-3:2013

And therefore conform(s) with the protection requirements of Council Directive 89/336/EEC relating to electromagnetic compatibility and Council Directive 73/23/EEC relating to safety requirements:

Issued on: **June 03, 2016**

Cliff Bredenberg
Chief Technology Officer

Glen Carlquist
Vice President of Manufacturing

F-QC-006 REV A

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WARRANTY

WPI (World Precision Instruments, Inc.) warrants to the original purchaser that this equipment, including its components and parts, shall be free from defects in material and workmanship for a period of one year* from the date of receipt. WPI's obligation under this warranty shall be limited to repair or replacement, at WPI's option, of the equipment or defective components or parts upon receipt thereof f.o.b. WPI, Sarasota, Florida U.S.A. Return of a repaired instrument shall be f.o.b. Sarasota.

The above warranty is contingent upon normal usage and does not cover products which have been modified without WPI's approval or which have been subjected to unusual physical or electrical stress or on which the original identification marks have been removed or altered. The above warranty will not apply if adjustment, repair or parts replacement is required because of accident, neglect, misuse, failure of electric power, air conditioning, humidity control, or causes other than normal and ordinary usage.

To the extent that any of its equipment is furnished by a manufacturer other than WPI, the foregoing warranty shall be applicable only to the extent of the warranty furnished by such other manufacturer. This warranty will not apply to appearance terms, such as knobs, handles, dials or the like.

WPI makes no warranty of any kind, express or implied or statutory, including without limitation any warranties of merchantability and/or fitness for a particular purpose. WPI shall not be liable for any damages, whether direct, indirect, special or consequential arising from a failure of this product to operate in the manner desired by the user. WPI shall not be liable for any damage to data or property that may be caused directly or indirectly by use of this product.

Claims and Returns

Inspect all shipments upon receipt. Missing cartons or obvious damage to cartons should be noted on the delivery receipt before signing. Concealed loss or damage should be reported at once to the carrier and an inspection requested. All claims for shortage or damage must be made within ten (10) days after receipt of shipment. Claims for lost shipments must be made within thirty (30) days of receipt of invoice or other notification of shipment. Please save damaged or pilfered cartons until claim is settled. In some instances, photographic documentation may be required. Some items are time-sensitive; WPI assumes no extended warranty or any liability for use beyond the date specified on the container

Do not return any goods to us without obtaining prior approval and instructions from our Returns Department. Goods returned (unauthorized) by collect freight may be refused. Goods accepted for restocking will be exchanged or credited to your WPI account. Goods returned which were ordered by customers in error are subject to a 25% restocking charge. Equipment which was built as a special order cannot be returned.

Repairs

Contact our Customer Service Department for assistance in the repair of apparatus. Do not return goods until instructions have been received. Returned items must be securely packed to prevent further damage in transit. The Customer is responsible for paying shipping expenses, including adequate insurance on all items returned for repairs. Identification of the item(s) by model number, name, as well as complete description of the difficulties experienced should be written on the repair purchase order and on a tag attached to the item.

** Electrodes, batteries and other consumable parts are warranted for 30 days only from the date on which the customer receives these items.*

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