Mantis

User's Guide

Original Instructions
Applies to Continuous Flow, LAM, ACC models, LC3
January 2016

MAG-V34R116

FORMULATRIX

Formulatrix Product Information

Formulatrix.com

Formulatrix Corporate Headquarters

10 DeAngelo Drive, Bedford, MA 01730 USA Phone: +1 781 788 0228

For information requests, email info@formulatrix.com. For sales inquiries, email sales@formulatrix.com. For support, email support@formulatrix.com. To comment on Formulatrix documentation, email publications@formulatrix.com.

Formulatrix European Representative

Flip Hoedemaeker

Support, Europe

Phone: +31 652 451106

flip@formulatrix.com

Table of Contents

Introduction **1**

Symbols and Conventions 2

Safety Information **3**

Introduction 3

Regulatory Compliance 3

Equipment Safety Guidelines 4

Mechanical Hazards 4

Electrical Hazards 4

Specifications **5**

Dimensions 5

Weight 5

Computer Requirements 5

Electrical Requirements 6

Specifications 6

Overview **7**

Key Features 7

Hardware Overview **9**

Mantis Components 9

Initial Setup **12**

Setting Up the Mantis 12

Adding Plate Types to the Plate Type Library 13

Adding Circular Plates to the Plate Type Library 15

Adding Stock Reagents to the Reagent List 18

Calibrating the Chip Port Positions 19

Calibrating Continuous Flow Chips 19

Software Overview **20**

Main Software Overview 20

Device Control Panel 22

Input Control Panel 25

Dispense List Designer 29

Status Bar....31
Dispense Protocol....31

Setting Up the Hardware....32

Dispensing With the Mantis....35

Designing a Dispense....35
Designing a Multi-Plate Dispense....37
Adding a Dispense Delay....39
Using Excel to Edit a Dispense Design....39
Creating and Using a Protocol....40
Priming the Chips....40
Executing a Plate Dispense....41
Recovering Excess Reagent Volume....41
Cleaning the Chips....42
Dispensing Rock Maker Plate Designs....43
Dispensing Formulator Plate Designs....44
Resolving Dispense List Errors....45

LC3: Large Capacity Chip Changer....46

LC3 Components....46
Setting Up the LC3 for a Dispense....49
Tuning the LC3 Carousel....50

Mantis Configuration....53

Configuring Mantis-Rock Maker Integration....53
Configuring Mantis-Formulator Integration....56

Fixing Drop Alignment....58

System Maintenance....60

Sterilizing Mantis Chips....60

Troubleshooting and FAQs....62

Troubleshooting....62
FAQs....64

Accessories....65

Index....67

Introduction

Chapter 1

Thank you for purchasing the Mantis, a low dead-volume, non-contact liquid dispenser. The unique design of this small machine minimizes dead volume and accepts pipette tip or tube inputs.

Your Mantis must be used in the manner described in this user's guide. Any other use may result in damage to your Mantis or personal injury. Formulatrix, Inc. is not responsible in whole or in part for any damages caused by: improper use, unauthorized alterations, adjustments or modifications, failure to comply with the procedures outlined in the Mantis User's Guide, or use of the products in violation of applicable laws, rules or regulations. Except as otherwise expressly provided in this user guide, any alteration, adjustment or modification to the products will void the product warranty.

Read, understand and observe all safety information and instructions in this manual before using your Mantis. Please note specific safety requirements as explained in this user's guide. Failure to follow these instructions could result in serious personal injury.

Please save this guide for future reference and have it available to all operating personnel.

The Mantis is manufactured to the current technical safety-relevant regulations.

Symbols and Conventions

This icon denotes a caution and advises you of precautions to take.

This icon denotes a prohibited action.

This icon denotes a compulsory action and advises you of actions you must take.

This icon denotes a caution relating to electric shock and advises you of precautions to take.

This icon denotes a fire hazard, and advises you of precautions to take.

This icon denotes a warning.

bold Bold text denotes items you must select or click in the software, such as menu items and dialog box options. Bold text also denotes parameter names.

`monospace` Text in this font denotes text or characters you should type from the keyboard.

Safety Information

Chapter 2

Introduction

The safety recommendations in this guide are basic guidelines. If the lab where the Mantis is to be kept has additional safety guidelines they should be followed as well, along with all applicable national and international safety codes.

Regulatory Compliance

Formulatrix products are CE (Conformité Européenne) Machinery, Low Voltage, and EMC directive compliant. If necessary, request the official Declaration of Conformity (DOC) from Formulatrix.

Only Formulatrix personnel are permitted to transport, assemble, or service the Mantis.

Use only parts supplied or recommended by Formulatrix in this document or via email.

Equipment Safety Guidelines

- ✓ Read all safety and operating instructions before operating the Mantis.
- ✓ Do not place the Mantis's facilities connections (power, waste lines and communications cables) where they could cause a safety hazard.
- ✓ Do not place the product in a location where it may be subject to physical damage.
- ✓ Ensure that all power connections to the product are properly grounded.
- ✓ Do not remove the nameplate, or any warning, hazard, or Equipment Identification labels.
- ✓ Turn OFF power before inserting or removing power cables.

Mechanical Hazards

The Mantis is a complex electromechanical instrument. Only persons with the proper training should service or operate the product.

All facilities to the product must be disconnected before servicing, or injury may result from the automatic operation of the equipment.

Electrical Hazards

The proper precautions for operating electrical equipment must be observed.

Avoid damage to the power cables. Do not apply unnecessary stress, place heavy objects on, or crush the cables or fire may occur.

Switch off all power sources before removing connectors or electric shock may occur.

Arrange cables in accordance with the Technical Standard for Electric Properties and Extension Rules or fire may occur.

Do not use extension cables unless approved by Formulatrix.

Specifications

Chapter 3

Dimensions

175 mm x 212 mm x 237 mm

(6.9" x 8.5" x 9.3")

Weight

~5 kg (~11 lb.)

Computer Requirements

- Computer OS: Windows XP Home Edition SP3 32-bit/Windows 7 Home Basic 64-bit/Windows Vista 32-bit/Windows 8
- 1 open USB Port
- Dual Core 1 GHz processor
- At least 1 GB RAM
- 1 GB Hard drive space
- 768 pixels vertical minimum screen resolution
- .NET Framework 3.5
- FTDI 2.08.24

Electrical Requirements

- 110 V - 240 V, 50 Hz - 60 Hz, 50 W typical, 150 W max
- Standard or European electrical outlet

Confirm that the power supply requirements are properly met to avoid material damage and fire.

The power supply for the system must meet or exceed electrical requirements of the system to avoid damage and risk of fire.

Specifications

- Width: 337 mm max (smaller without ACC or ingredient holders)
- Height: Full Extension: 237 mm (not including pipette tip input)
- Height: No Extension: 172 mm (not including pipette tip input)
- Depth: 217 mm (212 mm without ingredient holders)

Overview

Chapter 4

Key Features

Extremely Low Dead Volumes

To minimize dead volume, the ingredient plugs directly into the microfluidic chip. Dead volumes can be reduced to 6 µL by using pipette tips as ingredient reservoirs. This feature is ideal for dispensing even the most precious samples.

Optional Chip Changer

Mantis can automatically dispense up to six reagents, allowing you to dispense complex plates and assay development experiments.

Small Footprint

They say good things come in small packages, and the Mantis is no different. The Mantis is the smallest liquid handling robot made by Formulatrix and boasts one of the smallest footprints on the market.

With a base that fits on a standard mouse pad, the Mantis can fit in nearly any workspace while remaining robot accessible for automation.

Continuous Flow Dispensing (optional)

With optional continuous flow, the Mantis can pressurize an external bottle to dispense liquids at a constant dispense speed. This dispensing method allows for filling seven times faster (at a rate of 150 µL/second) than the previous Mantis. This increased dispensing speed is suitable for filling deep well blocks.

Dual Wash Stations

The dual wash stations built into the Mantis allow for easy sterilization during dispenses. One station can be used for bleach or alcohol for sterilization, while the second station contains water for a final rinse. If both Primary Wash Volume and Secondary Wash volume are non-zero, the Mantis will wash from Wash Station 1 first and then from Wash Station 2. If either of these volumes is set to zero, the software will skip that wash station.

Extended Plate Height Clearance for Deep Well Blocks

The dispense head of the Mantis has clearance up to 54 mm for dispensing into deep well blocks.

Patented Microfluidic Dispensing Technology

At the core of the Mantis is a patented microfluidic valve cluster that can measure and dispense discrete volumes of liquid. Pressure and vacuum are used to open and close each valve on the silicone valve cluster. This chip has two micro-diaphragms (100 nL / 500 nL or 1 µL / 5 µL depending on the chip option) that can fill and dispense as fast as 10 times per second.

Integrated Ingredient Holders (optional)

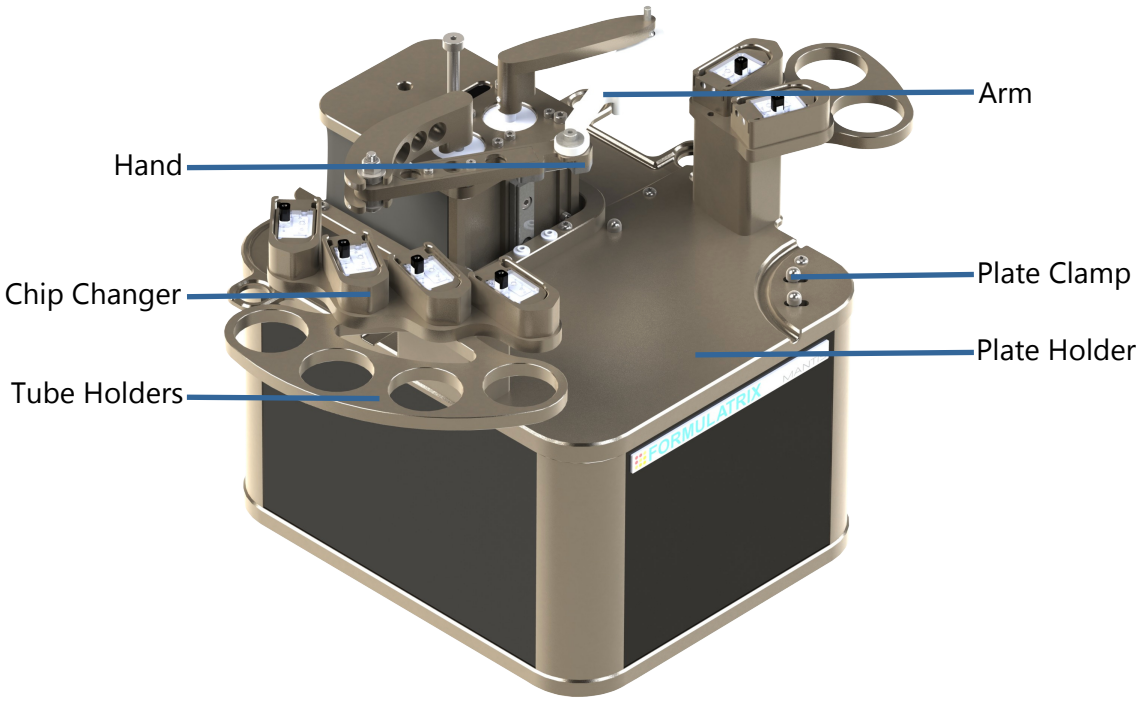
The Mantis comes fitted with removable ingredient holders that allow ingredients in 50 ml falcon tubes to sit safely during the dispense with no need for additional racks or risk of tipping/spilling.

Hardware Overview

Chapter 5

Mantis Components

MANTIS FRONT



Arms	The Mantis's arms control the hand movements when dispensing, loading and unloading chips.
Hand	The hand holds the High Volume (HV), Low Volume (LV), High Volume PFE, Low Volume PFE, or High Volume Continuous Flow (CF) chip during general operations.

Chip Changers

Using the chip changers, the Mantis can automatically dispense up to six reagents without user intervention. The chip changers are compatible with High Volume (HV), Low Volume (LV), High Volume PFE, Low Volume PFE, or High Volume Continuous Flow (CF) chips.

Plate Clamps

Located on the lower-right of the plate holder, the plate clamps align and secure the plate during the dispensing process.

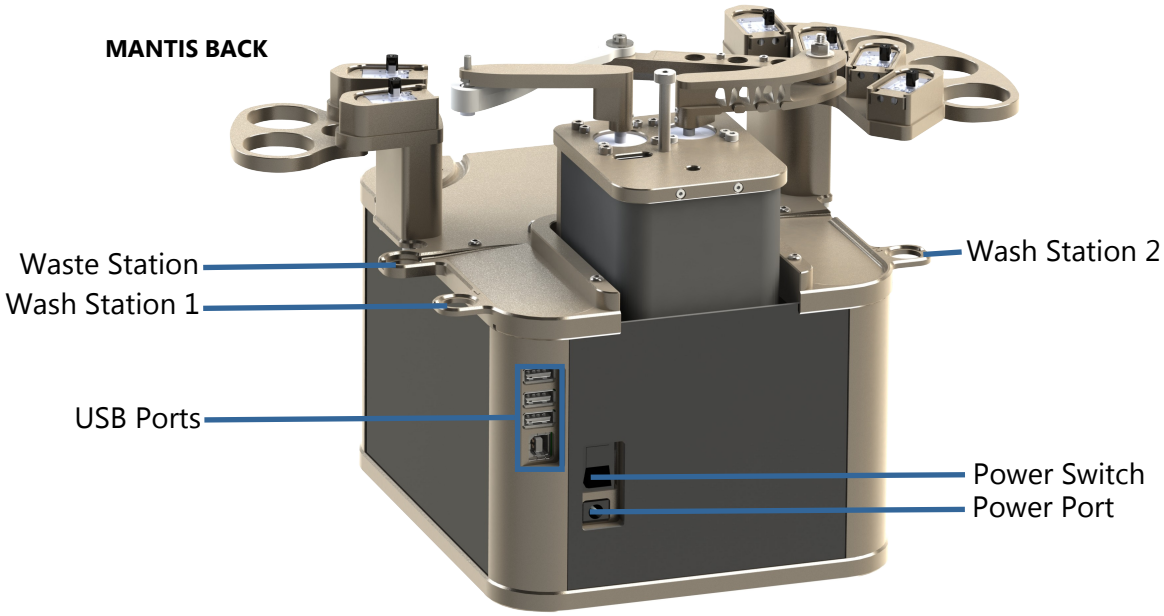
Plate Holder

The plate holder is compatible with almost all SBS plate types and deep well blocks.

Tube Holder

The tube holders are compatible with 50 mL Falcon tubes that are ideal for large volume dispenses or frequently used reagents.

MANTIS BACK



Waste Station

The waste station is a station for the Mantis to deposit waste liquids.

Wash Stations

The wash stations are where the Mantis holds wash solutions and water, used during the chip washing process. Wash solutions should go in Wash Station 1, and water should go in Wash Station 2.

USB Ports	The USB ports are where you plug the USB flash drive into the Mantis. Two of these ports are included for future expansion. The last USB port (located at the bottom) is used for connecting the Mantis hardware to your computer. The other end of the USB cable should be plugged into your computer.
Power Switch	The power switch turns the Mantis on and off.
Power Port	The power port is the area where you plug the power cable into the Mantis.

Initial Setup

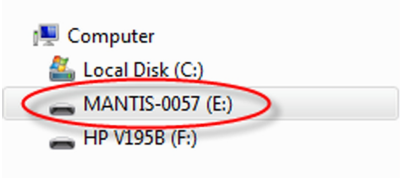
Chapter 6

Setting Up the Mantis

Setting up the Mantis for initial use means connecting all of the cables, setting up the wash and waste tubes and installing the .NET framework as well as the FTDI drivers to your computer.

To set up the Mantis for initial use:

1. Connect the power cable to the Mantis and plug it into an available outlet.
2. Connect the USB cable to the Mantis and plug it into your computer.
3. Find the power switch at the back of the Mantis and turn the Mantis **ON**.



4. Once your computer detects the Mantis, open Windows Explorer and locate the Mantis's USB drive. Look for **MANTIS-XXXX** (the X's represent your serial number).
5. Double-click the Mantis USB drive to display its contents.
    - Double-click the **Prerequisites** folder. You will see the **dotNET** and **CDM20824_Setup.exe** (FTDI driver). Install the dotNET driver and the FTDI driver. You will be asked to restart your computer once you install the FTDI driver.

- If you would like to have a shortcut for the Mantis's software on your desktop, open the **Mantis** folder, then open the **Bin** folder. Right-click the Mantis's software icon , then point to **Send to** and select **Desktop (create shortcut)**.
  The shortcut is dependent upon the drive letter dictated by the Mantis's USB connection. If at any time you disconnect the Mantis and plug it into a different USB port, the original desktop shortcut will no longer work.

Adding Plate Types to the Plate Type Library

Four plate definitions (including circular plate) come packaged with the Mantis for your convenience, but you may need to add additional plate definitions depending on the types of plates you use. To add a new plate to the Mantis's plate database, follow the instructions on this page.

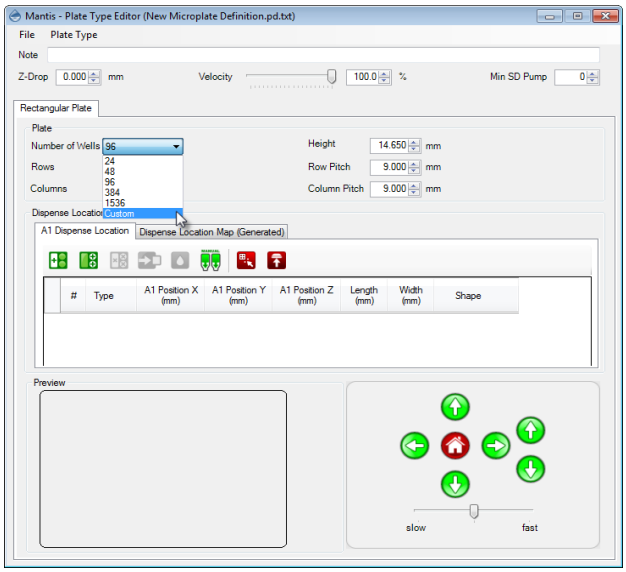
You must have at least one plate defined in Mantis before you can design a dispense. If you are defining a circular plate, please see "Adding Circular Plates to the Plate Type Library" on page 15.

Prerequisites

- You have the microplate data sheet that came with your new plate.
- You have attached a chip to the Mantis's hand.

To add a microplate to your plate library:

1. Go to the **Tools** menu and select **Plate Type Editor**.



2. Click the **Lock Plate Clamp** button .

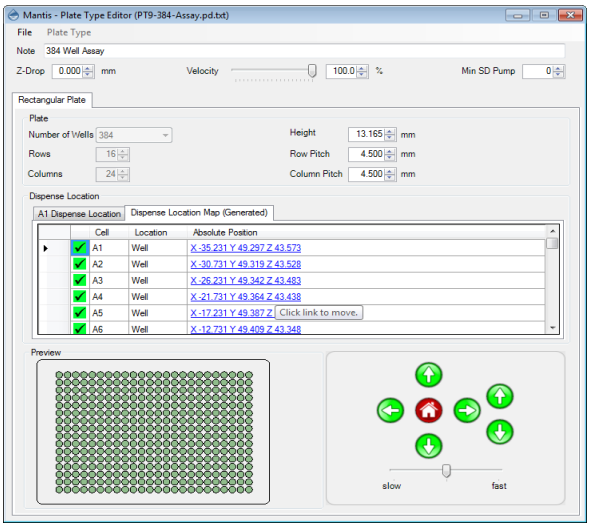
3. Click the **Move to Install Position** button  .
4. Place your new plate on the plate holder, and attach a chip to the Mantis's hand.
5. Select from the options below:
    a. To create a new plate, go to the **File** menu, click **New.**
    b. To modify an existing plate type, go to the **File** menu, click **Open**, then select a plate type and click **Open** again. The details for the plate you chose populate the Plate Type Editor.
6. In the **Note** box, type a name for your plate.
7. In the **Z-Drop** box, type the vertical distance you would like the Mantis to move down into each well before dispensing.
8. Select the Velocity percentage from the **Velocity** threshold.
    - 100% is recommended for most plate types.
    - 80% is recommended for 1536 well plates if dispensing causes the Mantis arms to wobble.
9. Type the number of minimum SD pumps in the **Min SD Pump** box.

Note: This feature is useful for preventing splashing when dispensing into round-or conical bottomed plates. If splashing occurs, setting this number to 4 or higher will greatly reduce or eliminate splashing.

10. Select the number of wells your plate contains from the **Number of Well** list.
11. Type the height of the plate in the **Height** box.
12. To set the A1 dispense location:
    a. Optional:
        - If you are using a plate type that is not available from the list, you will need to manually adjust the **Row Pitch** and **Column Pitch** values in the **Advanced** options. Measure the distance between one well center point to another in an adjacent row or column to get the Row Pitch or Column Pitch value.
        - Click and hold the **Manual Prime** button 

until the chip begins dispensing drops.
    b. Click the **Move To A1 Position** button  . The Mantis will go to the **A1** well location.
    c. Use the **Motion Control Pad** at the lower right of the Plate Type Editor to modify the A1 well position. Use the arrow keys to maneuver the Mantis's hand to the **A1** location of your plate. View the plate from both the side and the front to ensure your center location is correct.
    d. Click the **Test Dispense** button  to dispense a test drop to the **A1** well. The drop should be in the **A1** well.

13. Check the Mantis's dispense location settings: Click the **Dispense Location Map (Generated)** tab, and then click on any of the blue underlined text location links. The Mantis will move its arms to the related location. If the locations are inaccurate, repeat steps 11 through 13.



14. If you want to add coordinates for a drop locations (secondary or tertiary) on the plate, go back to the **Plate Parameters** tab, click the **Add Drop Location** button . Then repeat the steps you took to define the **A1** well location.

15. Go to the **File** menu, click **Save As,** type a name for your plate, and click **Save** .

    OR

    Go to the **File** menu and click **Save (CTRL+S)** to save your changes.

Adding Circular Plates to the Plate Type Library

Prerequisites

- You have the microplate data sheet that came with your new plate.
- You have attached a chip to the Mantis's hand.

To add a circular plate to your plate type library:

1. Go to the **Tools** menu and select **Plate Type Editor**.
2. Click the **Lock Plate Clamp** button .
3. Click the **Move to Install Position** button .
4. Place your new plate on the plate holder, and attach a chip to the Mantis's hand.
5. Select from the options below:

    a. To create a new plate, go to the **File** menu and click **New.** On the **Plate Type** menu, select **Circular.**

b. If you want to modify an existing plate type, go to the **File** menu, click **Open**, then select circular plate type and click **Open** again. The details for the plate you chose populate the Plate Type Editor.

6. In the **Note** box, type a name for your plate.

7. In the **Z-Drop** box, type the vertical distance you would like the Mantis to move down into each well before dispensing.

8. Select the Velocity percentage from the **Velocity** threshold.

   - 100% is recommended for most plate types.
   - 80% is recommended for 1536 well plates if dispensing causes the Mantis arms to wobble.

9. Type the number of minimum SD pump from the **Min SD Pump** box.

   Note: This feature is useful for preventing splashing when dispensing into round or-conical-bottomed plates. If splashing occurs, setting this number to 4 or higher will greatly reduce or eliminate splashing.

10. On the **Plate Parameters** tab, select the number of wells your plate contains from the **Number of Wells** list.

11. To set the plate's center point:

    a. Optional: Click and hold the **Manual Prime** button  until the chip begins dispensing drops.

    b. Type the Center Point Location of the **X**, **Y**, and **Z** axis in the available boxes. Then, click the **Move to Specified Center Position** button  to check the location.

    c. Use the **Motion Control Pad** at the lower right of the Plate Type Editor to modify the Center Point Location. Use the arrow keys to maneuver the Mantis's hand to the center position of your plate. View the plate from both the side and the front to ensure your center location is correct.

    d. Click the **Set Current Position as Center** button  once you are satisfied with the position.

    e. Click the **Test Dispense on Center** button  to dispense a test drop. The drop should be at the center position of your plate.

12. Set the A1 dispense location:

    a. Optional: Click and hold the **Manual Prime** button  until the chip begins dispensing drops.

    b. Type the A1 Dispense Location of the X, Y, and Z axis in the available boxes. Then, click the **Move to Specified Center Position** button  .

    c. Use the **Motion Control Pad** at the lower right of the Plate Type Editor to modify the A1 well position. Use the arrow keys to maneuver the Mantis's hand to the A1 location of your plate. View the plate from both the side and the front to ensure your center location is correct. View the plate from both the side and the front to ensure your center location is correct.

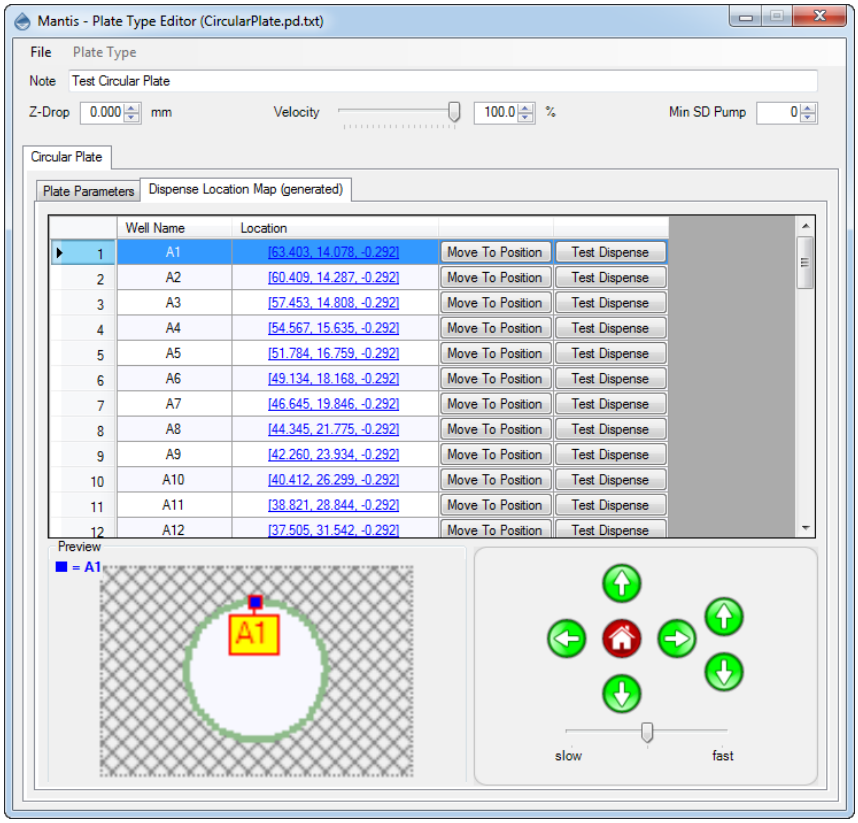
d. Click the **Set Current Position as A1** button once you are satisfied with the position.

e. Click the **Test Dispense on Center On A1** button to dispense a test drop. The drop should be at the center position of your plate.

13. Select either **Clockwise** or **Counter Clockwise** as the direction you would like the Mantis to dispense around the plate.

14. Set the well naming convention by typing a number in the **Repeat numbering every wells** box. For example, if you type '6', then the Mantis will name the first well A1, and after well A6 it will start naming wells with B1 until B6, and so on.

15. Check the Mantis's dispense location settings: Go to the **Dispense Location Map (Generated)** tab, and then click **Move to Position** button Move To Position . The Mantis will move its arms to the related location. If the locations are inaccurate, repeat steps 11 through 15. Otherwise, proceed to step 16.



16. Go to the **File** menu, click **Save As,** type a name for your plate, and click **Save** .

OR

Go to the **File** menu, click **Save (CTRL+S)** to save your changes.

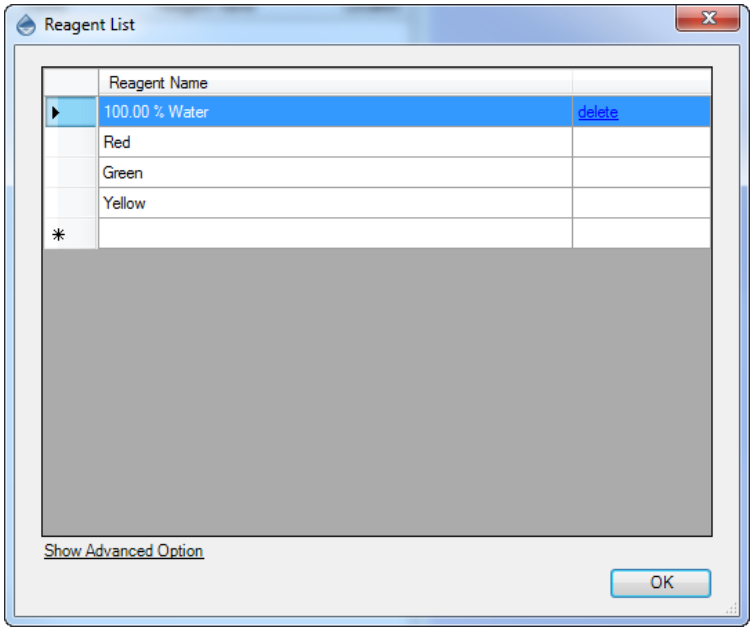
Adding Stock Reagents to the Reagent List

There are two ways to add reagents to the Mantis's memory: via the **Reagent List** or during Dispense List creation.

- The **Reagent List** is a list of reagents stored in the Mantis software's memory to be used at any time, in any dispense list.
- A **Dispense List** is a list of reagents to be used in a particular plate dispense.

To add stock reagents to the reagent list:

1. Go to the **Tools** menu, and click **Reagent List**.
2. Type the reagent's name in the blank row.



3. Continue adding reagents to new rows.
4. When you're done, click **OK**.

Calibrating the Chip Port Positions

If the Mantis is unable to smoothly pick the chip up from the chip port or your dispense locations are no longer accurate, you may need to tune the chip port position.

Prerequisites:

- You have removed the chip from the Mantis's hand.
- The chip is loaded on the chip port that you wish to calibrate.

To calibrate the chip port position:

1. Follow the on-screen instructions. On the **Tools** menu, click **Chip Changer Tuning**.
2. Follow the on-screen instructions.

Calibrating Continuous Flow Chips

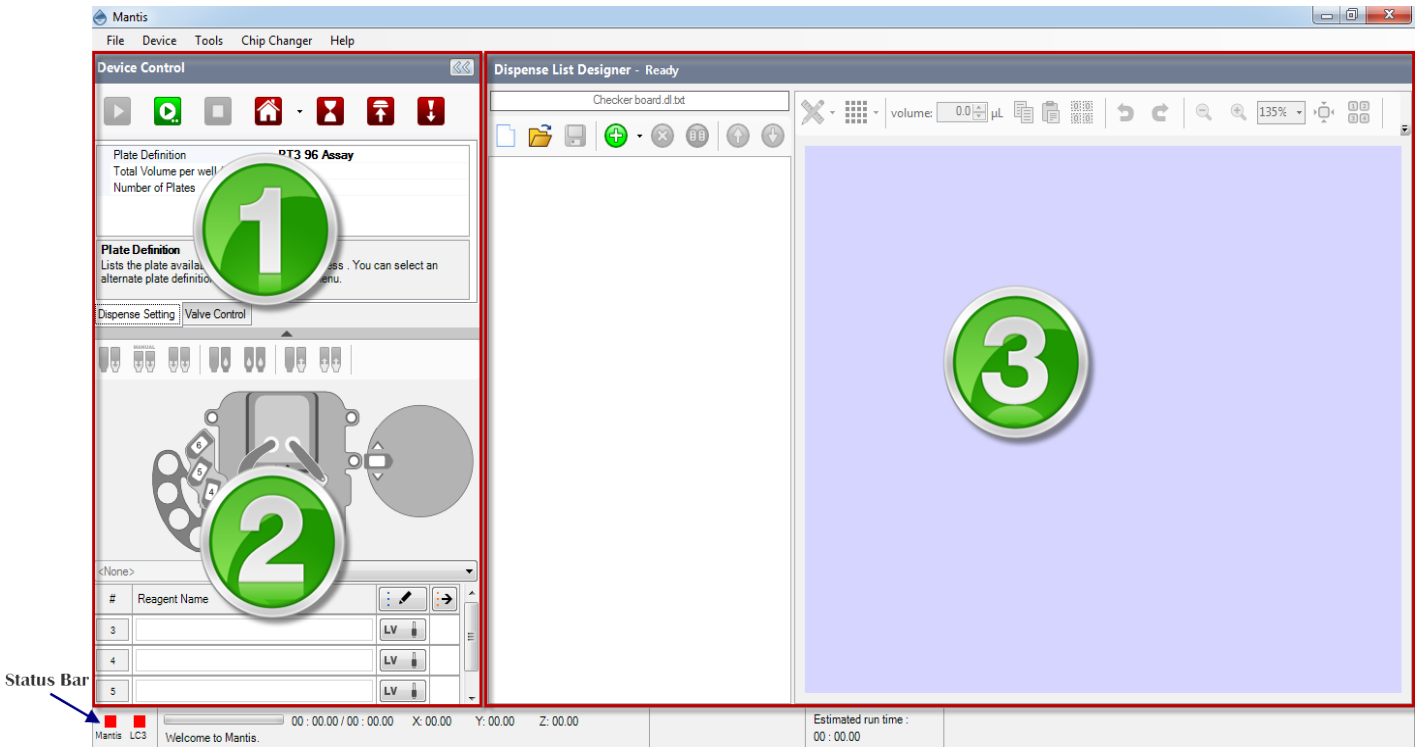
Continuous Flow chips must be calibrated whenever you want to use them with reagents that have not already been calibrated for continuous flow use. Continuous Flow chip calibration determines the amount of fluid dispensed per second.

To calibrate a Continuous Flow chip:

1. Go to the **Tools** menu and select **Continuous Flow Calibration**.
2. Next to **Reagent**, select the reagent you want to use with the Continuous Flow chip.
3. Next to **Chip**, select **Continuous Flow**.
4. Next to **Dispense Time**, type the number of seconds you want the Mantis to dispense the reagent for. If you plan to dispense 200 µL, 1 second is enough. For a 650 µL dispense, you should run a 3 second test. Type in fractions of a second like 0.5 second or less if you'd like to calibrate for smaller volumes.
5. Follow the on-screen instructions.

Software Overview

Chapter 7

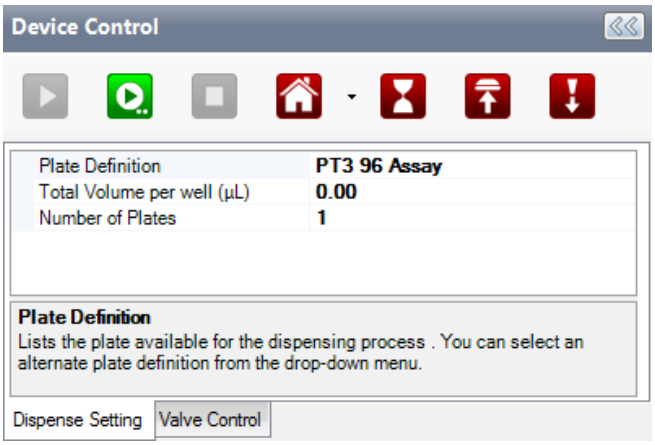


Main Software Overview

The Mantis control software is made up of three main panels and a status bar.

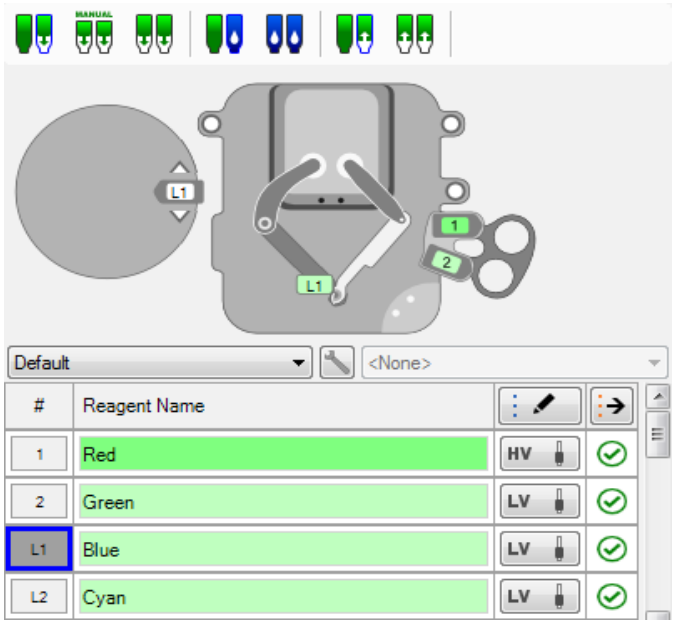
SECTION 1: DEVICE CONTROL PANEL

Section 1 is the top section of the Device Control panel. This is where you execute commands on the Mantis hardware using the buttons at the top, and view information about your plate definition, the total volume per well (µL) and number of plates to be dispensed. For more information, see “Device Control Panel” on page 22.



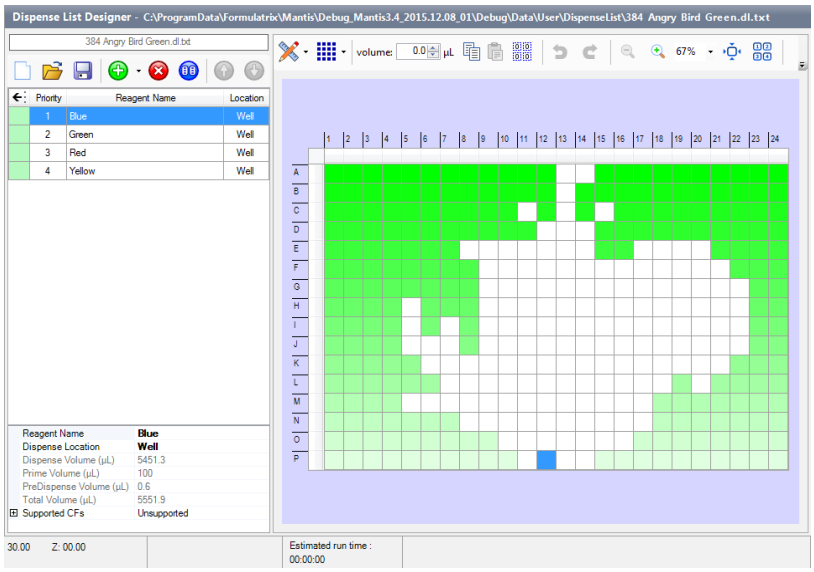
SECTION 2: INPUT CONTROL PANEL

Section 2 is the Input Control Panel. Use this panel to assign reagents to chip stations, run the wash, prime, and reagent recovery processes, and tell the Mantis whether you are using Low Volume (LV), High Volume (HV), High Volume PFE, Low Volume PFE, and High Volume Continuous Flow (CF) chips. For more information, see “Input Control Panel” on page 25.



SECTION 3: DISPENSE LIST DESIGNER

Section 3 is the Dispense List Designer. A dispense list is a list of reagents that will be dispensed to a plate. On the left is where a list of your reagents appear, and on the right is a visual representation of your plate. For more information, see “Dispense List Designer” on page 28.



STATUS BAR

The Status Bar shows you what's going on with your Mantis. For more information, see “Status Bar” on page 30.

Device Control Panel

The **Device Control panel** provides access to controls for operating the Mantis device. You will use it when you have designed a dispense and need to assign reagents to chips, or want to execute or pause a dispense.

The Device Control Panel is divided into four areas:

- Device Control Buttons
- Dispense Setting Tab
- Valve Control Tab
- Input Control Panel

Device Control Buttons

The buttons at the top of the device control panel execute different actions on the Mantis.

Clicking the **Run** button starts the plate dispense. This button changes to a pause button when clicked.

Clicking the **Run Dispense with Protocol** button starts the plate dispense using the saved protocols available.

The **Skip Dispense** button tells the Mantis to skip to the next reagent on the dispense list (not visible for ACC Mantises).

The **Stop** button stops the dispense.

The **Home** button homes the Mantis's motors, which can be useful if the Mantis is not dispensing as precisely as normal. When the LC3(s) attached, the home button can also home LC3 motors.

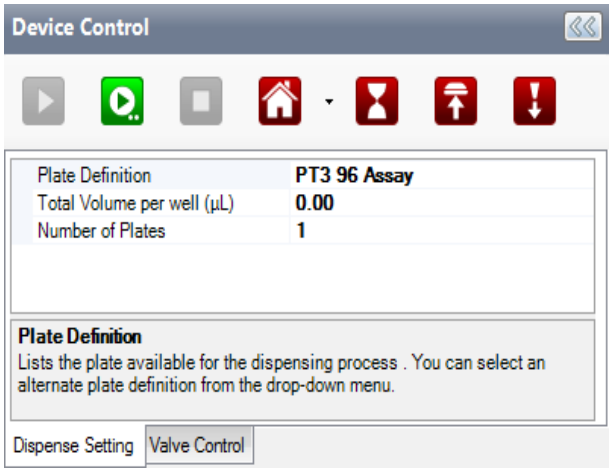
The **Move to Idle Position** button moves the Mantis's arms and hand to the rest position.

The **Move to Install Chip Position** button extends the Mantis's arms and hand so that you can more easily place the chip into place.

The **Move to Install Input Position** button moves the Mantis's arms and hand to a position that enables you to easily attach the pipette tip or input tube to the chip input.

Dispense Setting Tab

The Dispense Setting tab allows you to see and configure the Plate Definition and the Total Volume per well (µL) of a reagent. You can change the plate by clicking on the name of the plate and selecting a new plate from the list. Note that you can only change between plates with the same number of wells.



The **Total Volume per Well** field is populated only if every well has the same total volume.

The **Number of Plates** is where you specify the desired number of plates to be dispensed -- it is typically used for running a multi-plate dispense with a single dispense list.

Valve Control Tab

The Valve Control tab provides a visual representation of the microfluidic chip. Inside the microfluidic chip is a valve cluster that controls liquid circulation. This valve cluster has two micro-diaphragms, 0.1 µL (small) and 0.5 µL (large) in the low volume chip and 1 µL (small) and 5 µL (large) in the high volume chip.

Both chips have two valves: fill and output. The graphic display allows you to manually open (**green**) and shut (**red**) the valves by clicking on the representative area.

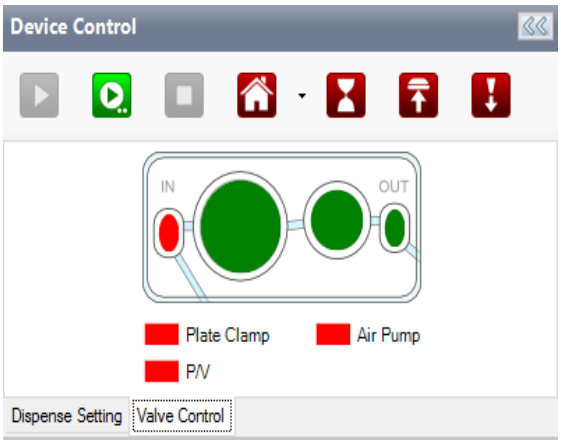


Plate Clamp

The plate clamp toggle is located below the microfluidic display. Its main function is to lock and align your plate when you run the dispensing process so that the plate does not move. The plate clamp is automatically active (**green**) when you run the dispensing process and is inactive (**red**) after the dispensing process is done. The plate clamp is pneumatic. Changing its state will activate the pump for a few seconds in order to actuate it.

Air Pump

The air pump toggle is located next to the plate clamp toggle. Its function is to turn the air pump on and off. The air pump provides adequate pressure and vacuum for the Mantis to run the dispensing, priming and washing processes. Red indicates that the air pump is inactive, and green indicates that it is active.

When you run the dispensing process, it takes two seconds (by default) for the air pump to start. The air pump will need to stabilize the pressure and vacuum before the Mantis runs the dispensing process.

P/V

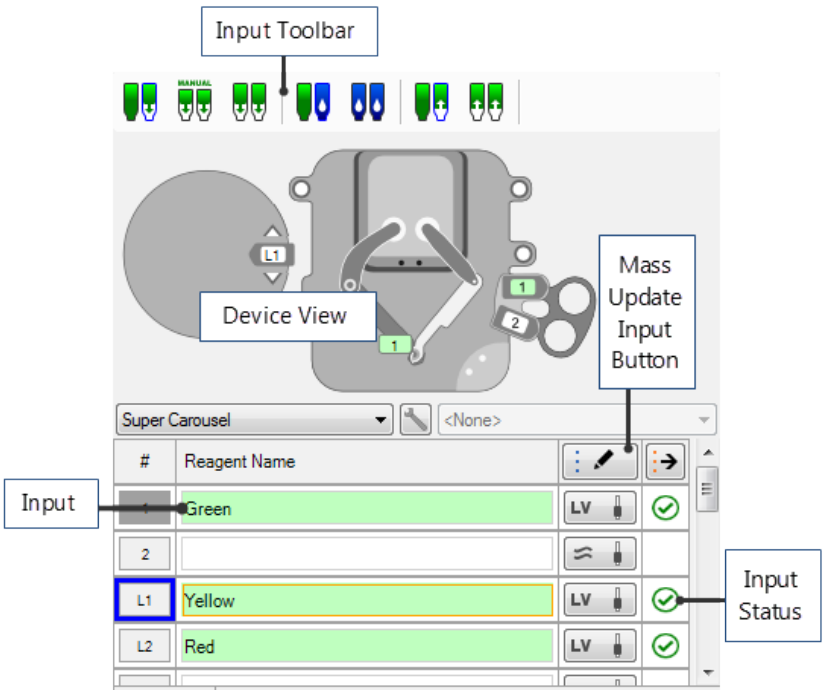
The Pressure and Vacuum toggle turns on and off the pressure in the bottle. A Continuous Flow (CF) chip needs to be on the hand for the bottle to be pressurized. Green indicates that the vacuum is active, and red indicates that the pressure is active. The Pressure and Vacuum toggle is available only if you are using the Continuous Flow (CF) chip for dispensing.

Input Control

The Input Control panel is represented by the image of the Mantis at the bottom of the Device Control panel. This is where you will tell the Mantis which chips are connected to specific reagents, run priming and washing processes, and execute the reagent recovery process.

You can assign a reagent to a chip location by dragging the name of the reagent from the Dispense List to the text box next to the chip number or the chip's location on the image of the Mantis. **OR** click the Assign To Input button  to assign all reagents in the Dispense List at once. You can then click the Mass Update Input button  or the Input button  next to every reagent name box to change the input source type (tube or pipette tip), chip type (Low Volume, High Volume, Low Volume PFE, High Volume PFE, or High Volume Continuous flow), and configure the prime volume, wash volume, recovery volume, and pre-dispense volume. To move all the unassigned inputs to the Dispense List, you can click next to the Mass Update Input button  . If you want to configure all of the input settings, click the Configure All Input Settings button  .

Understanding the Input Control Panel



Input Toolbar. The Input Toolbar provides you with seven dedicated buttons to perform specific Mantis operations, explained below.

Auto Prime

Clicking the **Auto Prime** button primes the chip with a fixed amount of reagent, controlled by the Input Option settings. Priming brings reagent through the chip so that when you begin a dispense the chip is not dispensing air.

Manual Prime

Clicking the **Manual Prime** button will prime the chip until you stop pressing the button.

Prime All Inputs Clicking the **Prime All** button will prime every chip that has a reagent listed in the Reagent Input Field.

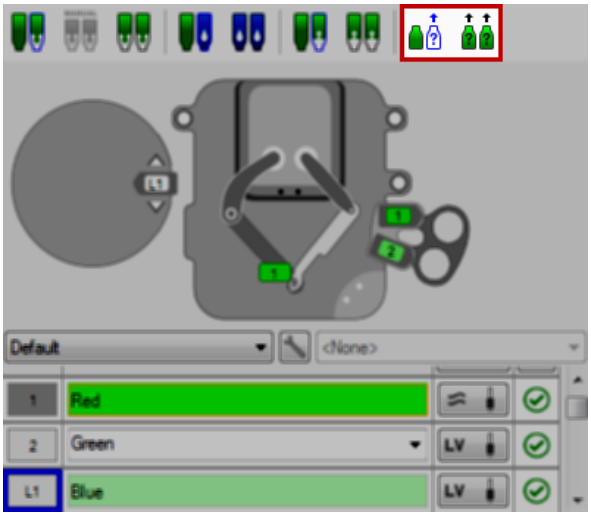
Wash Input Clicking the **Wash Input** button will wash the chip currently stationed at the Mantis hand.

Wash All Inputs Clicking the **Wash All Inputs** button will wash every chip that has a reagent listed in the Reagent Input Field.

Recover Input Clicking the **Recover Input** button runs the reagent recovery process on the chip currently stationed at the Mantis hand. Recovering a reagent will return most of the liquid in the chip and tubing to the source container.

Recover All Inputs Clicking the **Recover All Inputs** button runs the reagent recovery process on every chip that has a reagent listed in the Reagent Input Field. Recovering a reagent will return most of the liquid in the chip and tubing to the source container.

Besides the above buttons, Mantis also provides you with the two check bottle leak buttons, which only appear when Continuous Flow is active.



Check Bottle Leak on Mantis Arm Clicking the **Check Bottle Leak on Mantis Arm** button enables you to check any possible leaking pressure for a particular bottle on Mantis arm.

Check All Bottle Leak Clicking the **Check All Bottle Leak** button enables you to check any possible leaking pressure for all bottle(s) on Mantis arm.

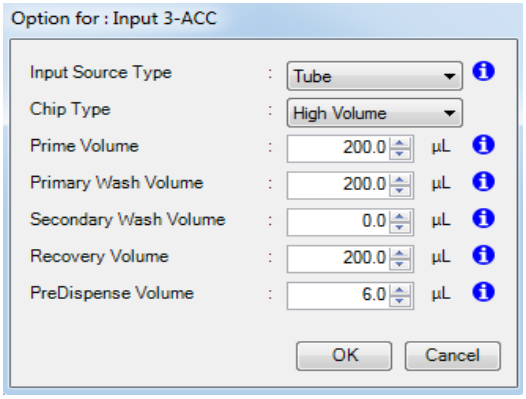
Device View. Device View displays the Mantis hardware in use. In the image displayed above, chip 1 is on the Mantis hand. Double-clicking one of the chips will cause that chip to be picked up by the Mantis hand. Double-clicking a second time will return the chip from the Mantis hand to the chip changer station. In the image above, you will also see the LC3 attached on the left side of the Mantis. It will only appear if you have the LC3 instrument in your system.

To add a reagent from the Dispense List to the Device View, drag it from the Dispense List to the reagent's chip changer station. OR click the **Assign To Input** button  to assign all reagents from the Dispense List at once.

Input. The Input tells you which reagent is assigned to which chip station. To the right of each reagent input field is a symbol or an abbreviation that represents the type of chip attached to that chip station. Options include:

LV	Low Volume Chip
HV	High Volume Chip
HVP	High Volume Chip PFE
LVP	Low Volume Chip PFE
≈	High Volume Continuous Flow Chip

Input Button Clicking the **Input** button enables you to change the input source type (tube or pipette tip), chip type (Low Volume, High Volume, Low Volume PFE, High Volume PFE, and High Volume Continuous Flow), and configure the prime volume, wash volume, and recovery volume, and pre-dispense volume.



Input Source Type. Click the **Input Source Type** list and select the desired input source type (Tube or Pipette Tip) for your experiment. The recommended length for tubing is 450 mm. The HV and LV chips use a slightly different tubing. The HV tubing is green while the LV tubing is white. Please make sure you have matched the tube and chip accordingly

Chip Type. Click the **Chip Type** list and select the desired chip type (**Low Volume**, **High Volume**, **Low Volume PFE**, **High Volume PFE**, or **HV Continuous Flow**) that you want to use. The actual chip should match the chip type selected.

Prime Volume. Type the desired volume to fill your tubing and/or chip channels in the **Prime Volume** box. The Mantis typically primes the chip only once at the beginning of the dispense to make sure all of the liquid channels are full. You will know the channels are full once reagent starts dispensing from the chip nozzle.

Primary Wash Volume. There are two wash stations on the Mantis. The primary wash is performed first, assuming you have the wash feature turned on in the **Options** menu. The volume will depend heavily on your application needs, but is typically at least equal to or greater than your Prime Volume. Commonly used wash solutions include water, 70% ethanol, and up to 10% bleach.

Secondary Wash Volume. There are two wash stations on the Mantis. The secondary wash is performed after the primary wash, assuming you have the wash turned on in the **Options** menu. The volume will depend heavily on your application needs, but is typically at least equal to or greater than your Prime Volume. Commonly used wash solutions include water, 70% ethanol, and up to 10% bleach.

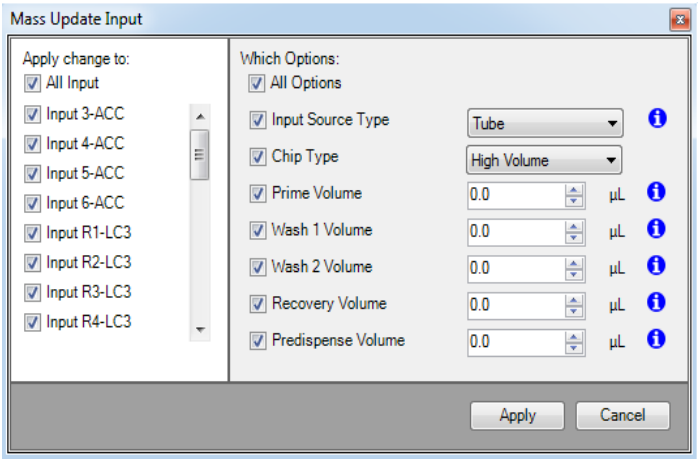
Recovery Volume. Type the desired reagent volume that you would like to return to your source container (pipette tip or tube) in the **Recovery Volume** box.

PreDispense Volume. Type the desired reagent volume that you would like to dispense to waste before dispensing into your plate in the **PreDispense Volume** box.

Note: You must calibrate each reagent for continuous flow. If you have not set up a reagent for continuous flow, click the **Calibrate for Continuous Flow** button and follow the on-screen instructions.

Mass update Input

If you have the same chip and input type for all chip stations, you do not need to configure each chip position individually. Click the **Mass Update Input** button to make changes to multiple chip stations at once.



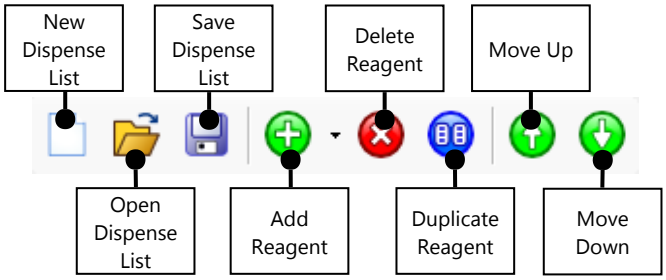
You can also access, modify and change the Input configuration through the **Configuration All Input Settings** button  .

Dispense List Designer

The Dispense List Designer is where you create or import a dispense list and plate dispense design. At the left of the Dispense List Designer is the Dispense List, which is a list of reagents to be used in a particular plate dispense. At the right of the Dispense List is a graphical view of your plate design. This area is where you design the dispense using the reagents in your Dispense List.

Dispense List Buttons

There are buttons along the top of the Dispense List that allow you to create a new dispense list, open an existing dispense list, add a new reagent to the dispense list, delete a reagent on the dispense list, duplicate a reagent on the dispense list, and increase or decrease the dispense priority of an item.



Reagent Information Box

At the bottom of the dispense list is a box of information that changes based on which reagent is highlighted in the dispense list. This table shows you the reagent's name, the dispense location, the reagent's barcode (if any), the dispense volume, the prime volume, the predispense volume, the total volume and the supported continuous flow chips. You can change these items if they are shown in bold text. To see your options, click anywhere in the text field of the bold text, then click the down-arrow to display the options.

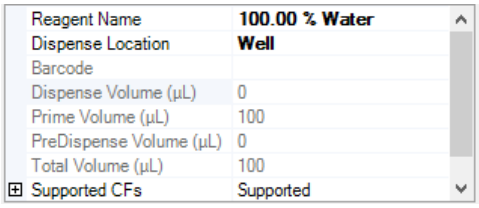


Plate Designer

The Plate Designer is used to design the plate dispense. You can click on a single well to select it; click and drag to select an area of wells, or hold down the `CTRL` key on your keyboard while clicking wells to select non-adjacent wells.

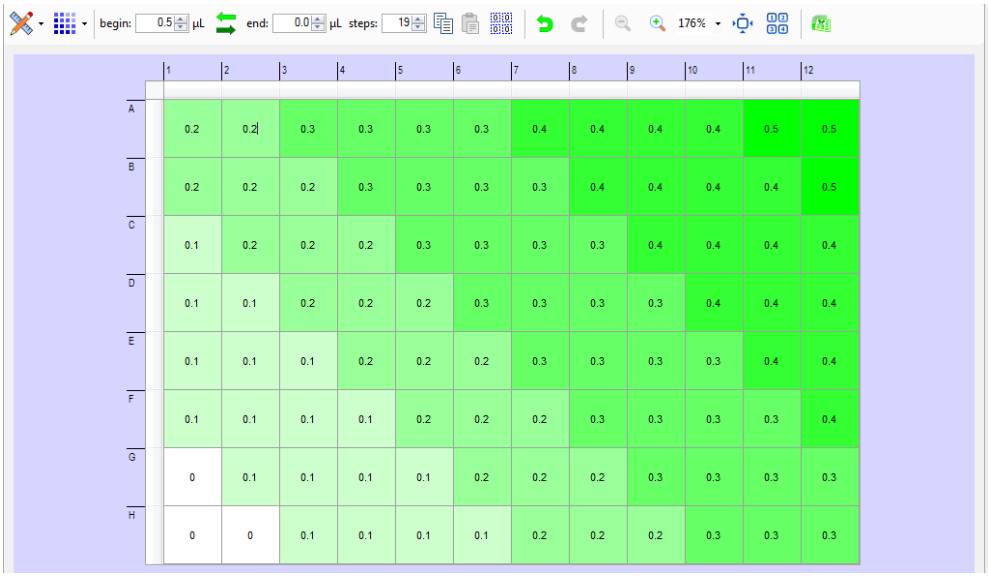
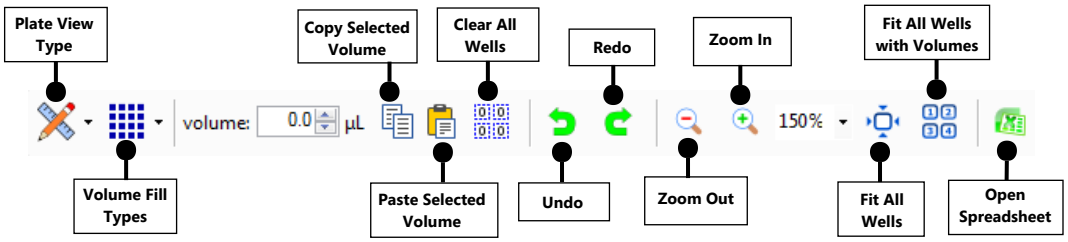


Plate Designer Toolbar Buttons

The Plate Designer has its own toolbar buttons that allow you to switch between Designer View, Summary View, and Volume Error View; change the volume fill type, undo and redo design actions; change the fit of the virtual plate on your screen; and edit a dispense design using a spreadsheet editor.

While most of your work will be done using Designer view (the default plate view), you can select other views by clicking the **Plate View Type** button from the toolbar at the top.

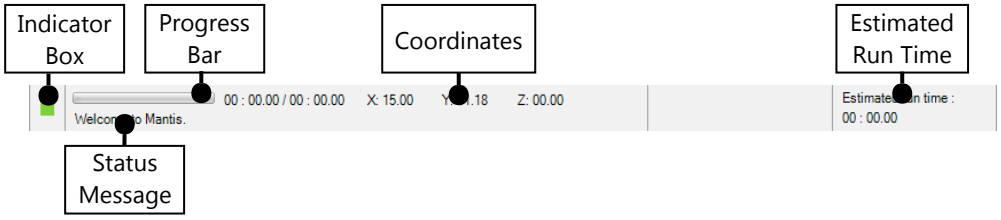


Volume Fill Types

The Volume Fill Type button displays a list that shows you different options for how to vary the volume across a selected area. The default setting is Constant Volume, but you can select either Horizontal Gradient, Vertical Gradient, Forward Diagonal Gradient, Backward Diagonal Gradient, Checkerboard 1, Checkerboard 2, Backfill or Scale.

Status Bar

The status bar, located at the bottom of the Mantis software, gives you up-to-date information about what's going on with your Mantis. It is divided into several sections, as shown below.



The indicator box will appear as either green, yellow, or red. If the indicator box is green, the Mantis software is connected to the Mantis hardware. Yellow means that you are operating in simulation mode, which means any actions taken in the software will not affect the hardware. Red means that the software is not connected to the hardware.

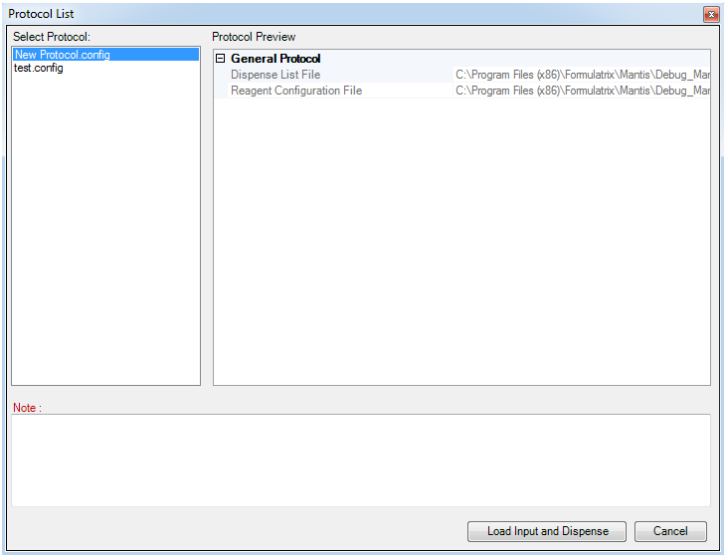
> **Tip**: You can enter simulation mode by clicking the indicator box.

Dispense Protocol

If you frequently use the same dispense list and/or plate design, you can save time by using a Dispense Protocol to save and load various dispense lists.

Protocol List

When you have created a dispense list and assigned reagents to chip locations, you can save the entire setup as a "protocol". Once you have saved a dispense as a protocol, you can load it at any time by going to the **Protocols** on the **File** menu and selecting **Load**, which will open the **Protocol List**.



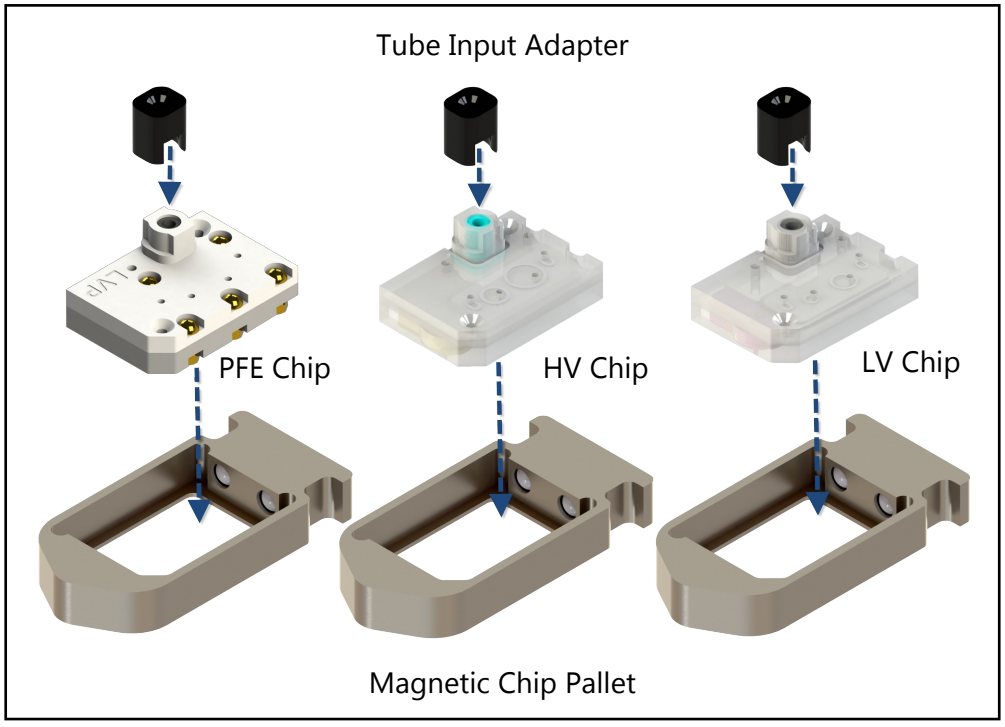
You can choose to load the "Input Setting" from a protocol only, which is the hardware setup; or both the hardware setup and the dispense list, which is your plate design, by selecting "Input and Dispense".

Setting Up the Hardware

Chapter 8

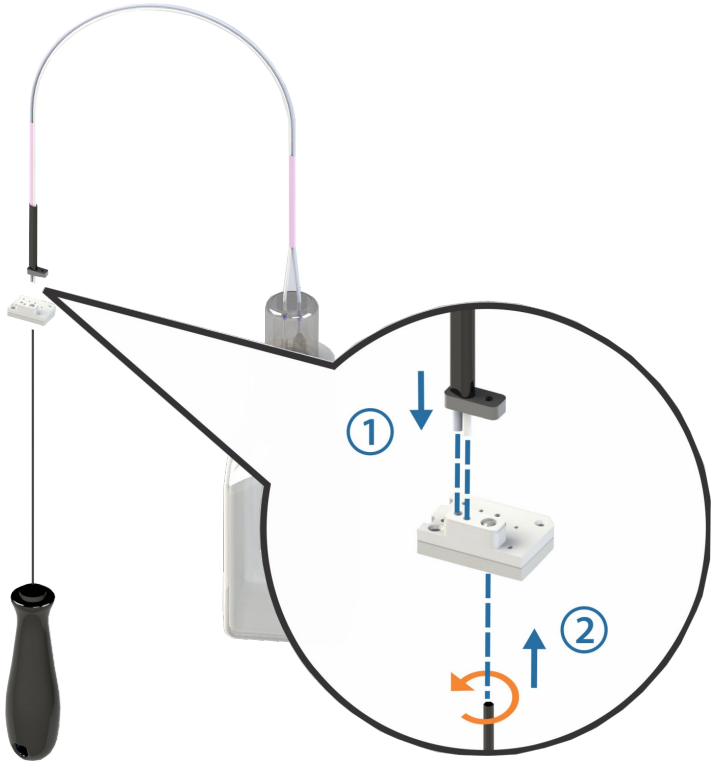
To set up the Mantis for a dispense:

1. Insert the High Volume (HV), Low Volume (LV), High Volume PFE, Low Volume PFE, or Continuous Flow (CF) chip into the chip pallet.

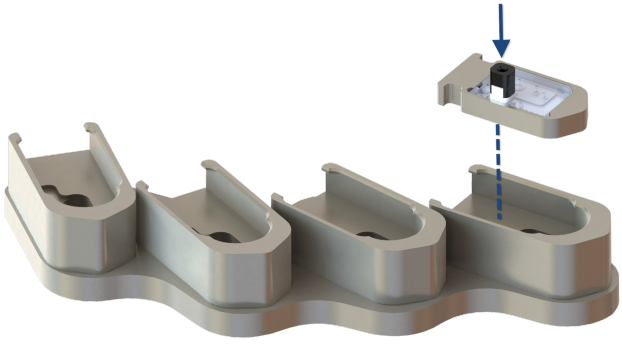


If you are dispensing to deep well blocks, you will need pressurized bottles and continuous flow chips. You will also need to calibrate the reagents for continuous flow use.

- Insert the tubes into the holes in the CF chip.
- Tighten the screw in the CF chip by using a 1.5 mm screwdriver.



2. Put the chip pallets into the chip port stations.



3. Attach the reagent tubes or pipette tips to the ingredient input at each chip. Skip this step if you are using CF chips.
    - If you are using a pipette tip, you will need to remove the black adapter from the chip's input.

4. Place your plate on the plate holder using the alignment pins to guide it into place.

5. Fill the wash container(s) with distilled water and/or wash solution (if you are using wash solution, you must follow the wash solution with a water rinse). Make sure that the wash container(s) contain enough water or wash solution and they are properly placed in the wash stations located at the back sides of the Mantis.

Note: Acceptable wash solutions include: Low molar (~0.01N) NaOH, 10% bleach, or 70% ethanol. Wash solutions should go in Wash Station 1, on the right side of the Mantis with the two chip stations.

6. Make sure that the waste container is installed in the waste station.

7. Proceed to the next step in the dispense process, designing a dispense with the software.

Dispensing With the Mantis

Chapter 9

Designing a Dispense

Once you have set up the hardware, you will use the Mantis control software to either open a dispense list or design a dispense.

Prerequisites

- You have at least one plate type already set up in the software.

To design a dispense:

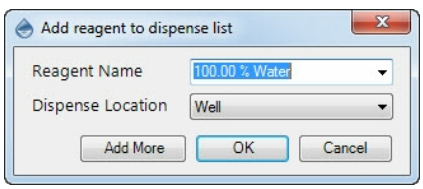
1. Choose from the following options:
   - Create a new dispense list: Click the **New Dispense List** button . Select a plate type and click **OK**.

     OR

   - Open an existing dispense list: Click the **Open Dispense List** button . Find your dispense list and click **Open**, then proceed to step 5.

     Note: You can skip these steps if you have loaded experiment designs from Formulator.

2. Add a reagent to the dispense list. Define the **Reagent Name** and **Dispense Location** and click **OK**. If you want to add additional reagents, click **Add More**.



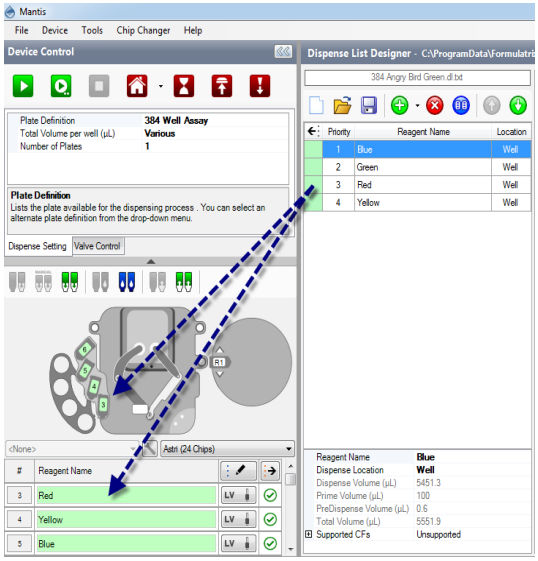
3. Begin designing your plate dispense with the plate designer:

   - Click and drag your mouse over a group of wells to select them.
   - For a **constant volume**, type in a volume and press **ENTER** on your keyboard.
   - To use a **gradient** design, click the small down arrow next to the **grid** button . You may choose a horizontal gradient, a vertical gradient, a forward diagonal gradient, a backward diagonal gradient, a checkerboard 1 or a checkerboard 2.
   - To add a **backfill** volume, click the small down arrow next to the **grid** button, and then click the **backfill** volume button.

4. Click the **Single Update Input** button 

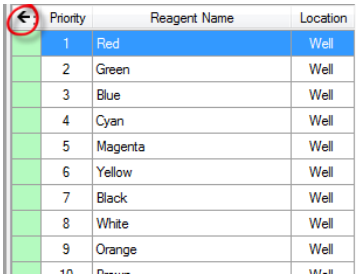
next to each reagent input. Select the **Chip Type** (Low Volume, High Volume, High Volume PFE, Low Volume PFE, or High Volume Continuous Flow chip), and type the **Prime Volume** (optional), **Primary Wash Volume, Secondary Wash Volume** (optional), **Recovery Volume,** and **Pre Dispense Volume**.

5. Drag the reagent name from the Dispense List to either the text box next to the chip position, or the chip position on the image of the Mantis.



OR

Click the **Assign To Input** button  to assign all reagents from the **Dispense List** at once.



Priority	Reagent Name	Location
1	Red	Well
2	Green	Well
3	Blue	Well
4	Cyan	Well
5	Magenta	Well
6	Yellow	Well
7	Black	Well
8	White	Well
9	Orange	Well

Note: If the dispense list has more reagents than the amount of the chip stations, the **Assign To Input** button will not work. The amount of reagents should be less or the same as the amount of the chip stations.

Designing a Multi-Plate Dispense

Once you have set up the hardware, you will use the Mantis control software to either open a dispense list or design a dispense.

Prerequisites

- You have at least one plate type already set up in the software.

To design a dispense:

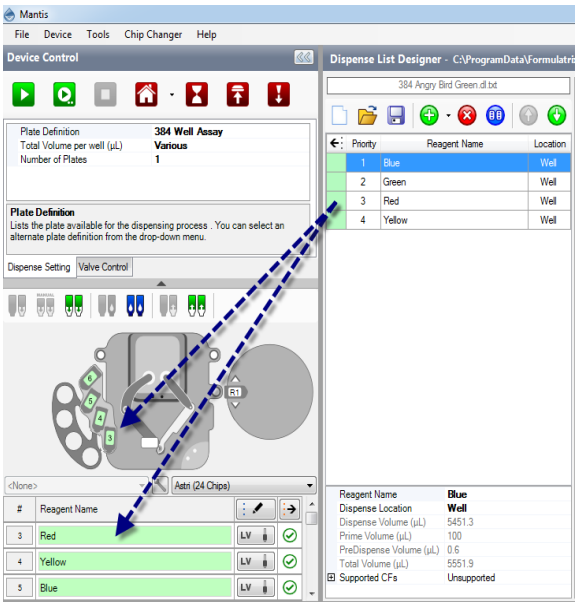
1. Choose from the following options:
   - Create a new dispense list: Click the **New Dispense List** button  . Select a plate type and click **OK**.

     OR
   - Open an existing dispense list: Click the **Open Dispense List** button  . Find your dispense list and click **Open**, then proceed to step 5.

     Note: You can skip these steps if you have loaded experiment designs from Formulator.
2. Add a reagent to the dispense list. Define the **Reagent Name** and **Dispense Location** and click **OK**. If you want to add additional reagents, click **Add More**.
3. Begin designing your plate dispense with the plate designer:
   - Click and drag your mouse over a group of wells to select them.
   - For a **constant volume**, type in a volume and press **ENTER** on your keyboard.
   - To use a **gradient** design, click the small down arrow next to the **grid** button . You may choose a horizontal gradient, a vertical gradient, a forward diagonal gradient, a backward diagonal gradient, a checkerboard 1 or a checkerboard 2.
   - To add a **backfill** volume, click the small down arrow next to the **grid** button, and then click the **backfill** volume button.
4. Click the **Single Update Input** button 

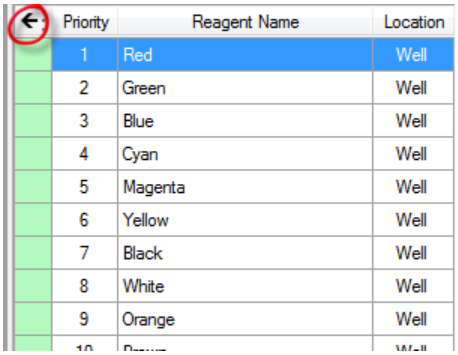
next to each reagent input. Select the **Chip Type** (Low Volume, High Volume, High Volume PFE, Low Volume PFE, or High Volume Continuous Flow chip), and type the **Prime Volume** (optional), **Primary Wash Volume, Secondary Wash Volume** (optional), **Recovery Volume,** and **Pre Dispense Volume**.

5. Drag the reagent name from the Dispense List to either the text box next to the chip position, or the chip position on the image of the Mantis.



OR

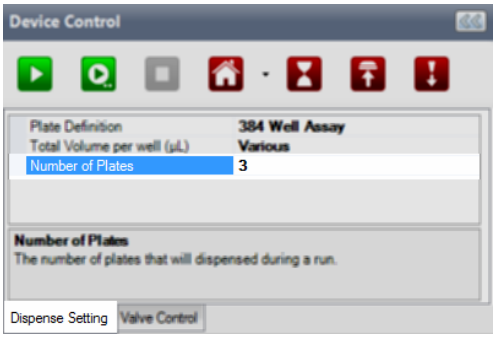
Click the **Assign To Input** button  to assign all reagents from the **Dispense List** at once.



Priority	Reagent Name	Location
1	Red	Well
2	Green	Well
3	Blue	Well
4	Cyan	Well
5	Magenta	Well
6	Yellow	Well
7	Black	Well
8	White	Well
9	Orange	Well

Note: If the dispense list has more reagents than the amount of the chip stations, the **Assign To Input** button will not work. The amount of reagents should be less or the same as the amount of the chip stations.

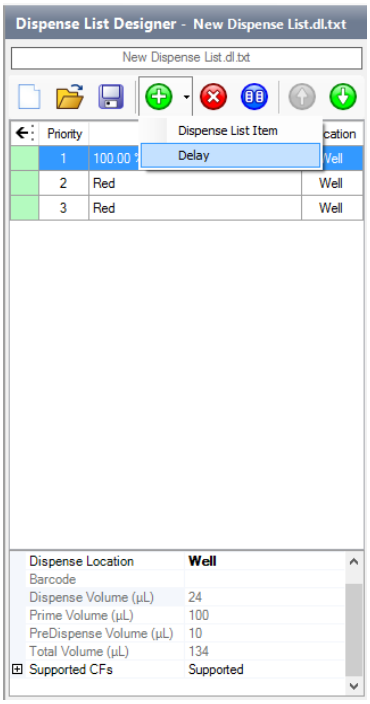
6. On the **Dispense Setting** tab, type the amount of plates you want to dispense in the **Number of Plates** field.



Adding a Dispense Delay

To add a dispense delay to a dispense list:

1. Click a dispense list item to select it.
2. Click the black-down arrow next to the plus button .
3. Select **Delay**.
4. Go to the bottom of the dispense list designer and choose a **Delay Type** (UserInput or Timer).
5. **Optional**: If you selected Timer, type the number of seconds in the **Delay Time (s)** field. You can also leave a message in the **Message** box to be displayed when the dispense delay is running.



Using Excel to Edit a Dispense

You can use Microsoft Excel or OpenOffice to view and edit your experiment data if you prefer that method over a visually-oriented designer.

Prerequisites

- You have loaded a dispense list to the Dispense List Designer.

To edit a dispense list with Excel or OpenOffice:

1. Click the **Excel** editor button on the right area of the Dispense List Designer. A lock button will appear on the dispense list, and the Excel or OpenOffice editor will display the dispense list items and their volumes.
2. Edit the volumes manually. If you are trying to create a new dispense design based on an existing spreadsheet, you can now copy and paste the dispense volume data from the existing spreadsheet to the Mantis-formatted spreadsheet. Your volumes must be in microliters.

Note: If you attempt to edit a dispense design in Excel, any reagents left with zero volume will be removed from your dispense list when you save your changes and return to the Mantis software.

3. Save the changes in Excel, or click the **X** in the upper-right corner to exit Excel. If you click the X, you will be asked if you want to save your changes. Click **Yes**.
4. Please be patient while Mantis reads your changes and renders them in the Mantis software. Once the conversion is complete, your dispense list is unlocked and you may interact with your design in the Mantis's Designer View.

Creating and Using a Protocol

Using a dispense protocol is convenient if you find that you use the same hardware setup or plate design several times.

To create a protocol:

1. Design a plate dispense and assign each reagent to a chip as normal.
2. Go to the **File** menu, point to **Protocols** and then select **Save**.
3. Type a name for the protocol in the **File name** field, and click **Save**.
4. To load the protocol in the future, go to the **File** menu, point to **Protocols** and then select **Load**.
    a. Select the protocol from the list in the **Select Protocol** box.
    b. Click **Load Input and Dispense** to load both the hardware setup and the dispense design.

Priming the Chips

It's important to prime the chips before every dispense to ensure that the reagent has moved through the chip to the dispense point, so that you are dispensing liquid and not air. At this point, you should have already designed a dispense (or opened an existing dispense).

Prerequisites

- You have set up the hardware.
- You have designed a dispense.

To prime all of the chips:

- Click the **Prime All Inputs** button  if you want the Mantis to prime each chip attached to the Mantis

To prime an individual chip:

1. If you want to prime an individual chip, right-click on the reagent in the **Device Control** panel and select **Attach Input to Hand**.
2. Click the **Manual Prime** button 

if you don’t know how much reagent you need to dispense in order to prime the chip. Once you see a drop of reagent come out of the bottom of the chip, the chip is primed.

OR

Click the **Auto Prime** button  if you want to prime the chip with the fixed prime amount (as defined in the input options menu).

You are now ready to execute the dispense!

Executing a Plate Dispense

To dispense a plate design:

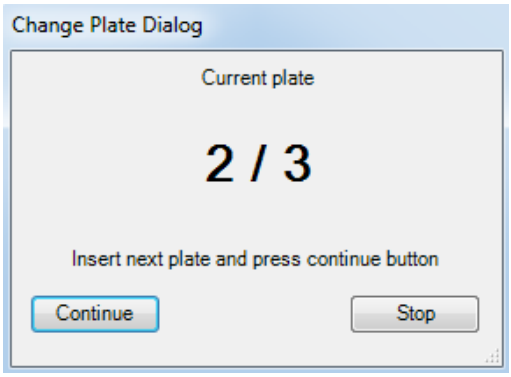
- Click the **Run Dispense** button  .

  OR

  Press **F5**.

When the dispense finishes, if you are not planning to dispense more than one plate, you can run reagent recovery to conserve reagent volume (optional), or proceed directly to washing the chips.

If you're running multi-plate dispensing, the **Change Plate Dialog** will appear. You can either continue the dispense or abort it. If you want to continue, place your next plate on the plate holder and click **Continue**. Click **Stop** to abort the dispense.



Recovering Excess Reagent Volume

The reagent recovery process forces reagent out of the chip into the input tube or pipette tip. Run Reagent Recovery when you want to conserve reagent volume.

Prerequisites

- You have executed a plate dispense.

To recover reagent volume from all inputs:

- Click the **Recover All Inputs** button  .

To recover reagent volume from individual inputs:

- Right-click on a reagent in the **Device Control** panel and select **Attach Input to Hand**.
- Click the **Recover Input** button  .

Important: We recommend that you wash the chips after each use, please see “Cleaning the Chips” on page 41 for further details.

Cleaning the Chips

It’s important to clean the chips after each use to prevent cross-contamination and the formation of dried reagent buildup. Before you begin, remove any reagent tubes from the reagent bottles and direct them to a waste container.

You can use a wash solution in one wash station and water in the other, and follow wash solution rinses with water rinses.

Prerequisites

- You have executed a plate dispense.
- You have set up the wash solution.
- You have put the input tubes into a waste container.

To clean all chips:

1. To wash all inputs at once, click the **Wash All** button  .

To clean an individual chip:

1. To wash individual inputs, right-click a reagent on the **Device Control** panel and select **Attach Input to Hand**, then click the **Wash Input** button  .
2. Repeat the wash process on each input until you can no longer see reagent leaving the chip in the reagent tube.
3. Repeat the wash process on each input until you can no longer see reagent leaving the chip in the attached tube.
4. You may want to run the **Reagent Recovery** process a second time to ensure the inside of the chip is dry.

Dispensing Rock Maker Plate Designs

Mantis can be integrated with Rock Maker to dispense a plate design you've created in Rock Maker.

Prerequisites

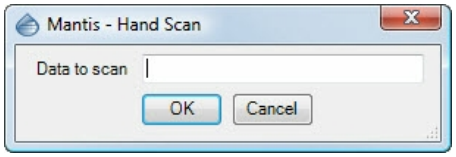
- You have configured Mantis-Rock Maker integration. For more information, please see “Configuring Mantis-Rock Maker Integration” page 53.
- You have used Rock Maker to create an experiment (if you haven't and you need help, please see the Rock Maker help files for assistance).

To run Rock Maker experiments with Mantis:

1. Place the Mantis’s chips into the chip pallets, and attach the chip pallet to a chip changer station.
2. Attach the reagent tubes or pipette tips to the ingredient inputs at each chip.

   Note: If you are using a pipette tip, you will need to remove the black adapter from the chip’s input.

3. Place the microplate on the plate holder. The microplate you use should be the same one you selected in Rock Maker.



4. Go to the **Tools** menu and select **Hand Scan**.
5. Type your experiment barcode number next to **Data to scan** (you only need to type the last four digits). If Mantis successfully reads and validates the barcode, your dispense list, design and settings will display.
6. Drag the reagents from the **Dispense List Designer** panel to the corresponding inputs.
7. Click  to start the dispense or click  to run dispense with protocol. The Mantis will complete your plate dispense design.
8. **OPTIONAL**: If you want to conserve reagent volume, run **Reagent Recovery.**
9. When you're finished dispensing, clean the chips. For more information, please see “Cleaning the Chips” page 42.

Dispensing Formulator Plate Designs

If your lab is equipped with both the Formulator and Mantis, the two liquid handlers can be integrated so that non-precious reagents are dispensed with the Formulator, and precious reagents are dispensed with the Mantis.

Prerequisites

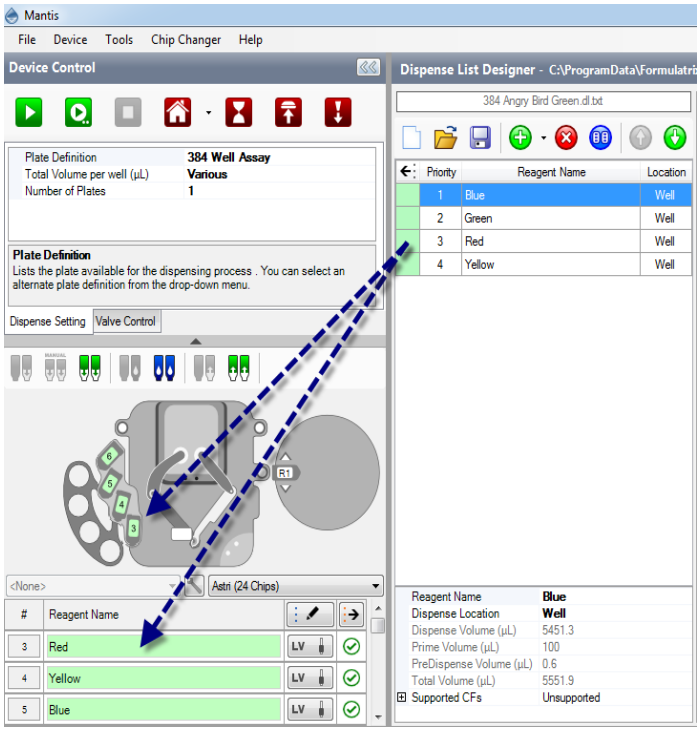
- You have configured Mantis-Formulator integration. For more Information, please see "Configuring Mantis - Formulator Integration" page 56.
- You have sent reagents from the Formulator software to the Mantis software.
- The plate definition names are the same in Mantis as they are in Formulator.
- If you are dispensing some reagents with the Formulator, you have already performed this part of the process.

To run Formulator experiment designs with Mantis:

1. Place the Mantis's chips into the chip pallets.
2. Attach the reagent tubes or pipette tips to the ingredient inputs at each chip.

> **Note**: The dispense list imported from Rock Maker is configurable after import, however any changes will not be reflected in Rock Maker.

3. Place the microplate on the plate holder.
4. Drag the reagents from the **Dispense List Designer** panel to the corresponding inputs.

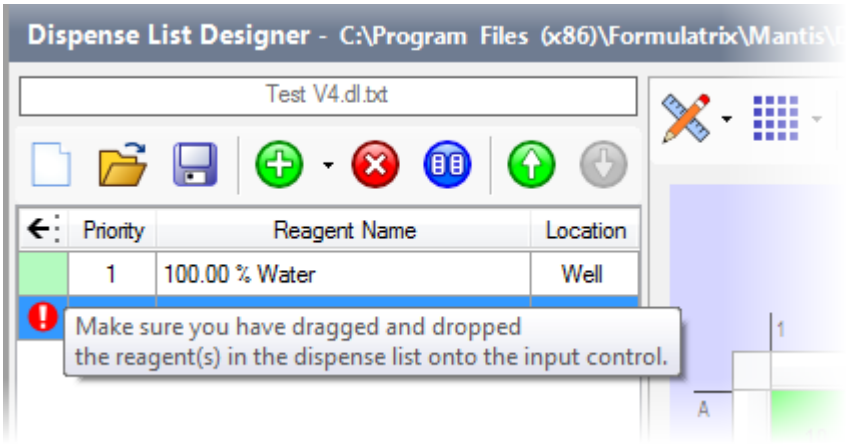


5. Attach your reagents to the Mantis's chips (if you are using pipette tips, you will need to remove the black adapter from the chip's input first).
6. Click  to start the dispense or click  to run dispense with protocol.
7. The Mantis will complete your plate dispense design. You may now run Reagent Recovery (optional). When you're finished dispensing, please clean the chips.

Resolving Dispense List Errors

If you see a red exclamation point icon next to a reagent on your dispense list, it means that there is a problem with your dispense list item. In many cases, mousing over the exclamation point will display text that explains how to resolve the issue.

For example, in the scenario below, you would resolve the issue by dragging the reagent to its location on the input control panel.



LC3: Large Capacity Chip Changer

Chapter 10

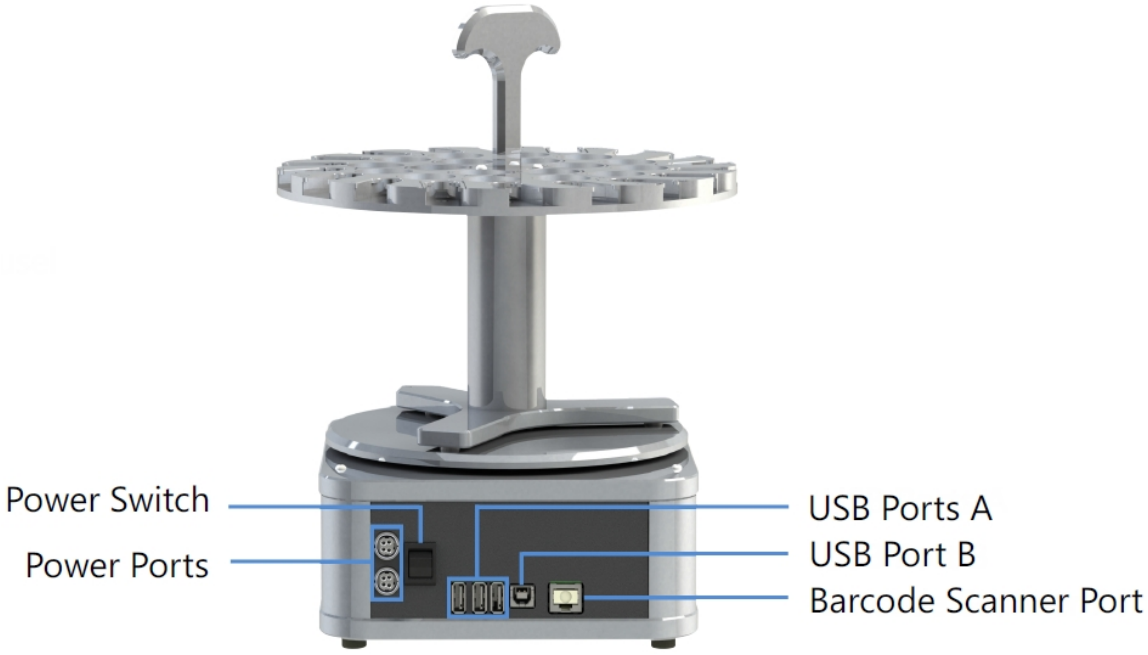
LC3 Components

LC3	The LC3 is the base for the chip changer carousel. It has several components such as power ports, USB ports and a barcode scanner port.
Carousel	The chip changer carousel consists of chip stations and tube holders. There are two types of carousels, a 24-chip and 18-chip.

Tube Holder — Depending on the type of LC3 carousel you use, the tube holder is compatible with either 15 mL Falcon tubes or 50 mL Falcon tubes.

Chip Station — The chip stations are compatible with High Volume (HV), Low Volume (LV), High Volume PFE, Low Volume PFE, and High Volume Continuous Flow (CF) chips.

LC3 BACK

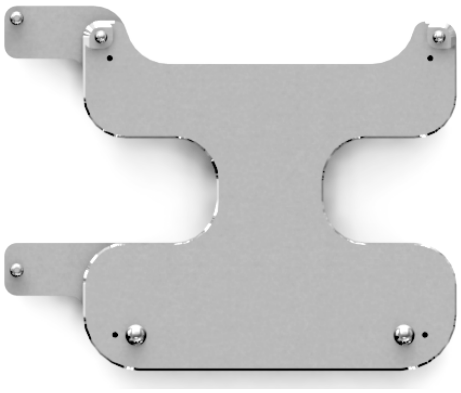


Power Switch — The power switch turns the LC3 on and off.

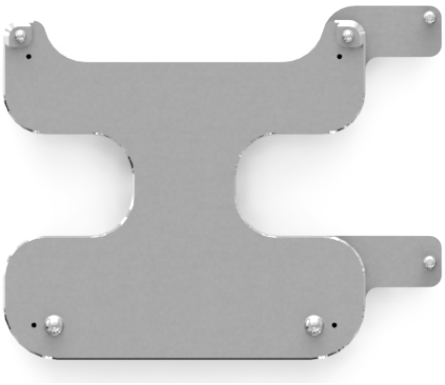
Power Ports — There are two power ports, one for connecting the LC3 to the Mantis, as the Mantis can power itself off of the LC3; and one for connecting the LC3 to a power outlet.

USB Ports — There are four USB ports, three Type A and one Type B. The Type B port is used for connecting the LC3 to your Mantis. The other three can be used for USB flash drives.

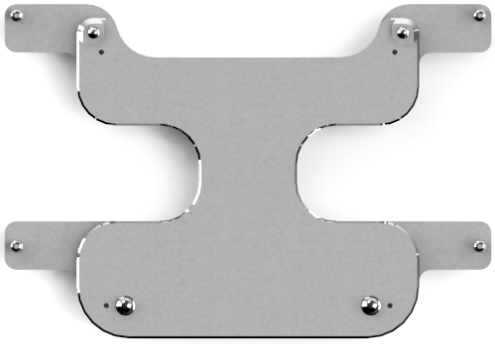
Locating Plate



Left Position



Right Position



Right-Left Position

Locating Plate

The function of the locating plate is to align the LC3 with the Mantis.

There are three different locating plates: Left, Right and Right-Left. The locating plate shipped with your Mantis depends on your specific order.

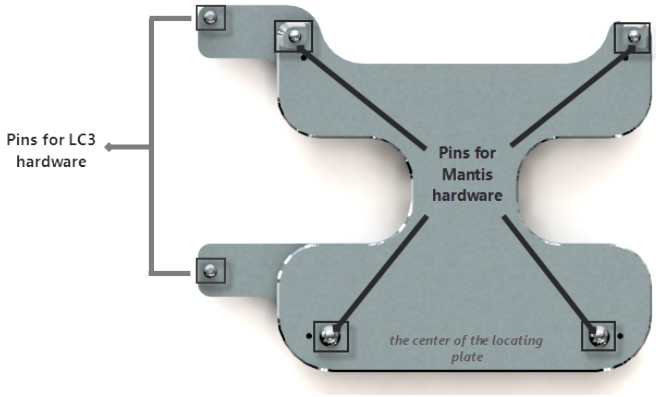
Setting Up the LC3 for a Dispense

Prerequisites:

- You have the LC3 option, along with the carousel and a locating plate
- You are familiar with the component names of the LC3 hardware (see LC3 Components on page 46)

To set up the LC3 for a dispense:

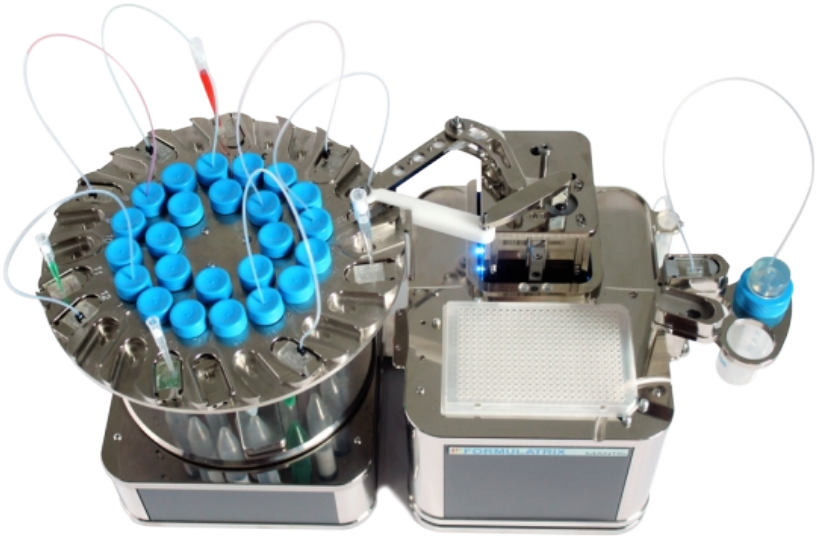
1. Locate the Mantis on the center of locating plate by lining up the pin slots under the Mantis base to the locating plate's pins.
2. Locate the LC3 to the pins on the locating plate by lining up the pin slots under the LC3 base to the locating plate's pins.



3. Position the carousel on top of the LC3.

4. Put the Mantis's chips into the chip stations.
5. Attach the reagent tubes in the tube holders or pipette tips to the inputs at each chip.

6. Put your plate on the Mantis's plate holder.



7. Fill the wash container(s) with distilled water or wash solution (if you are using wash solution, you must follow the wash solution with a water rinse). Make sure that the wash container(s) are properly placed in the wash stations located at the back sides of the Mantis.

Tuning the LC3 Carousel

You must calibrate the LC3 before initial use and whenever the Mantis fails to pick up and return a chip from a chip station on the LC3.

LC3 calibration requires two processes, tuning the "locked" position and tuning the "unlocked" position. The "locked" position is the position of the chip when the Mantis picks up a chip from a chip station. "Unlocked" refers to the chip position when the Mantis returns the chip to the chip station.

Prerequisites:

- The Mantis is connected to the LC3, and the LC3 and Mantis indicators on the status bar are green.
- The chip must be placed in the chip station labeled '1' on the carousel that you wish to tune and you have removed the chip from the Mantis's hand.

To Tune the LC3

1. Go to the **Chip Changer** menu and select **Tuning**.
2. Select from the options below:
    - If the LC3 carousel is at the left of the Mantis, click **L1** on the Image of the LC3 carousel. In the example below, the LC3 carousel is positioned at the left of the Mantis.
    - If the LC3 carousel is at the right of the Mantis, click **R1** on the image of the LC3 carousel. The image you see will differ from the example image below.

3. Click **Next** and follow the on-screen instructions.

   - If you have previously configured your carousel, select a carousel name from the available list on the bottom-left of the **Auto Chip Changer Tuning** window. Click the **Rename** button  to change a carousel name, and click the **Delete** button  to remove an existing carousel from the list.

   - If you would like to tune a new carousel, select **New Carousel**, select the carousel type from the **Carousel Type** list, and then type a name for your carousel.

4. Click **Next**.

5. In the first three steps of this wizard, you will configure the "locked" position of the chip. Stand up and look down at the Mantis. Using the motion controls, align the edges of the metal Mantis arm with the walls of the chip station.

6. Position the Mantis hand so that the front point of the chip is directly above the front point of the chip pallet.

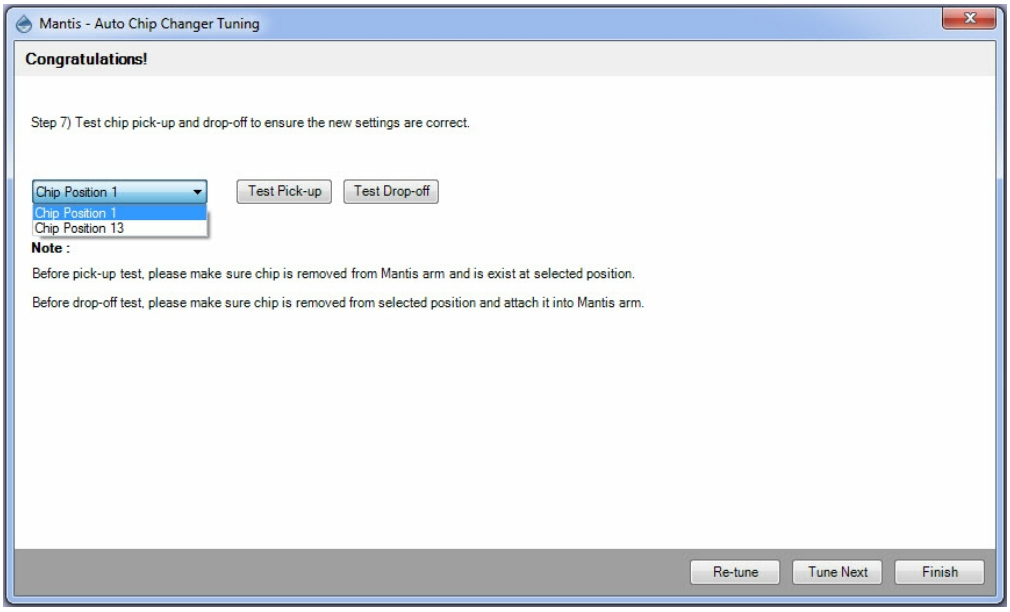
7. Use the motion controls to tweak the position of the arms and hand as necessary. Lower the hand into the chip station until the magnet picks up the chip, making sure that the arms remain parallel to the ground and are not flexed in an upward or downward position.

8. You will now configure the "unlocked" position. Remove the chip from the chip pallet, and attach it to the Mantis hand.

9. Align the metal Mantis arm with the walls of the chip station. Then, position the hand above the chip station, this time aligning the tabs on the chip pallet with the indents at the edge of the chip station.

10. Lower the chip into the chip station, being careful to keep the arms of the Mantis parallel with the ground. If the position is correct, the Mantis will leave the chip in the chip station.

11. Test pick-up and drop-off for both chip positions to ensure the new settings are correct.



Note: If you have the 18 chip carousel, you can test for position 1 and position 10. If you have the 24 chip carousel, you can test for position 1 and position 13.

12. If you are satisfied, click **Finish**. Otherwise, click **Re-tune** to re-tune the chip position.
13. **Optional**: Click **Tune Next** to tune another chip position or another carousel.

Mantis Configuration

Chapter 11

Configuring Mantis-Rock Maker Integration

There are some basic settings you need to configure if you want to be able to dispense Rock Maker plate designs with Mantis.

Prerequisites

- You are running Mantis 2.3 or newer.
- You are running Rock Maker 2.0 or newer.

Step 1: **Set up Rock Maker – Mantis Integration:**

1. Open **Mantis.exe.config** in the Mantis directory, where the Mantis software is installed.
2. Specify the user setting location in this key `<add key= "UserSettings.Location"` value to create the Extension folder and check that the settings in this key `<add key="Common.SharedFiles.Entries"` value is same with the **Shared** folder location of Rock Maker.

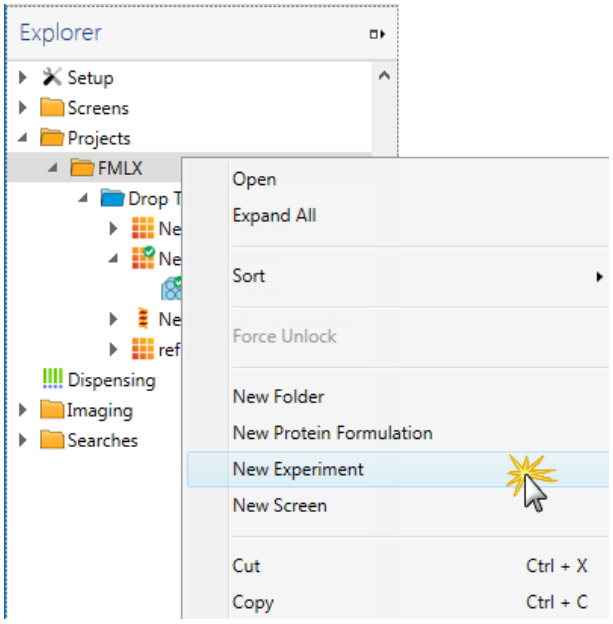
```
<add key="AlternateDirectory.Temp" value="${TMP}\Formulatrix\Mantis\2\Temp" />
<add key="ClientSettingsProvider.ServiceUri" value="" />
<add key="UserSettings.Location" value="E:\Liquid Handling\Mantis\Software\Mantis 2.5\Mantis" />
<add key="Common.SharedFiles.Location" value="E:\Rock Imager\RockMaker\RM 2.8\RockMaker-2.8\Shared" />
<add key="Common.SharedFiles.Entries" value="RockMaker\DispensingUtility:RockMaker.Business.dll:Extensions\Ro
<add key="Common.SharedFiles.Configuration.RetriesLimit" value="1" />
```

3. When you're done, point to the **File** menu and click **Save** to save your changes.

Step 2: Test Mantis – Rock Maker Integration

1. Open the Rock Maker software and create a new experiment:

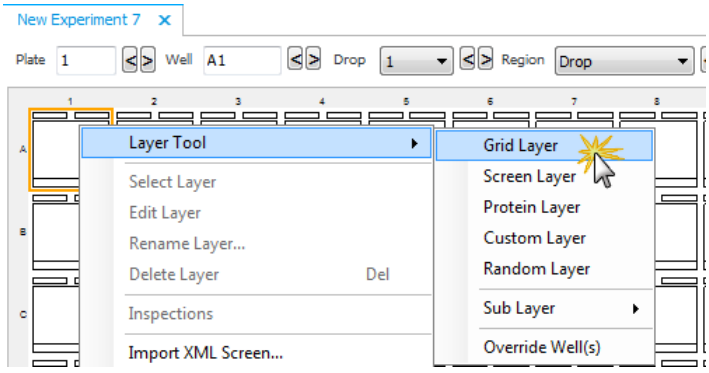
   a. From the tree, right-click a project or a folder within a project and select **New Experiment**.



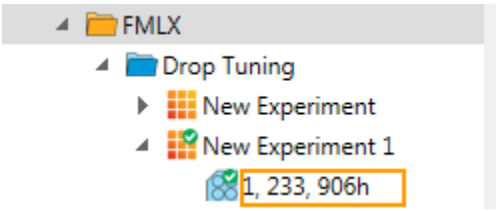
   b. Rename the experiment by typing over the default name on the Explorer. Try to be as descriptive as possible.

   c. Fill in the fields on the **Experiment** tab such as **Plate type**.

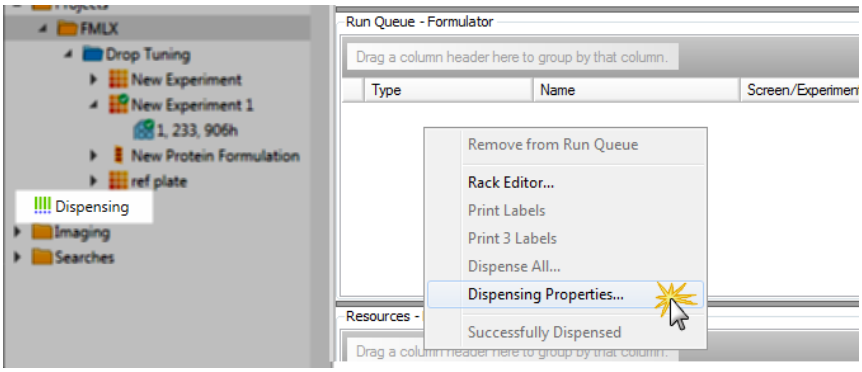
   d. Go to the **Canvas** tab and make a new grid layer consisting of ingredients and protein.



   e. Save your changes by selecting **Save** from the **File** menu. The experiment barcode displays in the **Explorer** tree.

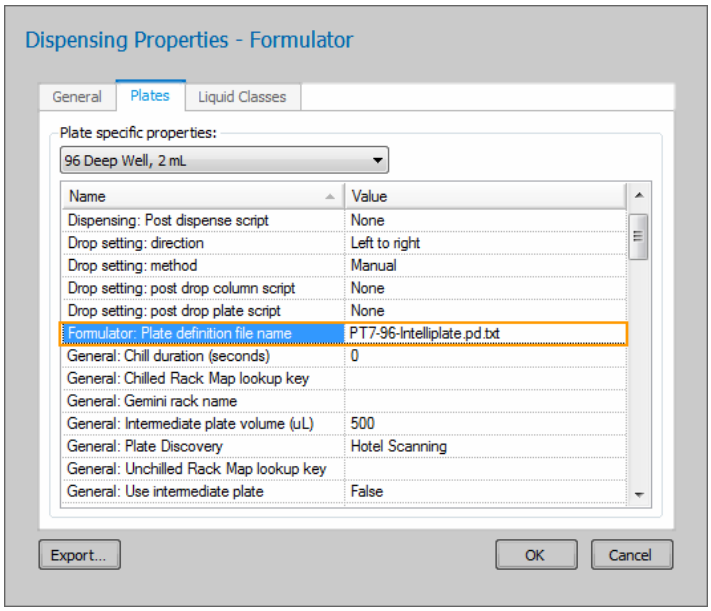


f. Point to **Dispensing** folder, right-click **Run Queue** and select **Dispense Properties**.



g. Select the **Plates** tab and change the plate-specific properties based on the plate type used in your experiment.

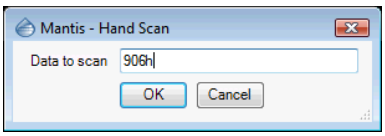
h. Next, go to the **Formulator: Plate definition file name** column. You need to get the exact name of the plate definition file name from the Mantis directory, so open the Mantis directory and go to `Mantis\Data\User\Plates`.



i. Click **OK** to confirm.

2. In the Mantis software, point to the **Tools** menu and click **Hand Scan (CTRL+H)**.

3. Type your experiment barcode number in the **Data to scan** box (you only need to type the last four digits). If Mantis successfully reads and validates the barcode, your dispense list, design and settings will display.



Configuring Mantis-Formulator Integration

There are some basic settings you need to configure if you want to be able to dispense Formulator experiment designs with the Mantis.

To access these settings, go to the **Tools** menu and select **Options**. You may need assistance from your network administrator to configure these settings correctly if you are running Mantis and Formulator on different computers.

Prerequisites

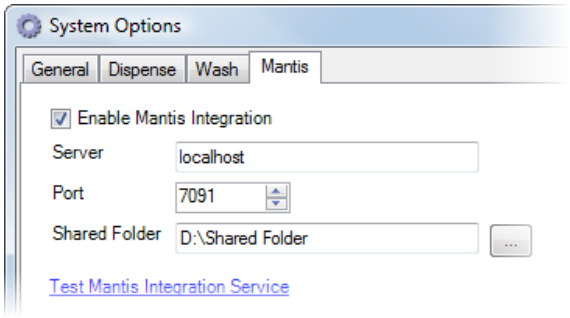
- You are running Mantis 2.3.2 or newer.
- You are running Formulator 1.15 or newer.

Step 1: Configure Mantis-Formulator Integration with the Mantis Software

1. Go to the **Tools** menu and select **Options**.
2. Set **Start IS Remotely** to ALLOW, ASK or DENY:
    - **ALLOW** -- Formulator has full permission at all times to send dispense lists to the Mantis.
    - **ASK** -- A notification will appear on the computer that runs the Mantis. You must grant permission each time the Formulator wants to send a dispense list to the Mantis.
    - **DENY** -- The Formulator will NOT be allowed to send dispense lists to the Mantis.
3. Verify that the plates you plan to use have the same name in Mantis as in Formulator:
    - On the **Tools** menu, click **Microplate Editor**. A dialog box opens.
    - On the **File** menu, click **Open**.
    - Navigate to the plate definition files for the plates you plan to use in your experiments. Verify that it is exactly the same name as in the Formulator's microplate definition library. (In Formulator's **Advanced View**, point to the **File** menu and click **Open**, then select **Microplate Definition** and find the plate definition.)

Step 2: Configure Mantis-Formulator integration with the Formulator Software

1. On the **Tools** menu, click **Options**.
2. Click the **Mantis** tab and perform the following actions:
   a. Select the **Enable Mantis Integration** check box.
   b. Next to **Server**, type in the server information. If Mantis and Formulator are running on the same computer, type `localhost`.
   c. Next to **Port**, leave the default setting (7091) unless your system administrator instructs you to enter another port.
   d. Next to **Shared Folder**, click ... and select a folder that both Mantis and Formulator have access to. If you are running Mantis and Formulator on the same computer, any folder will work.
   e. Click the blue **Test Mantis Integration Service** link to test the settings. The Mantis software **must** be running for Mantis integration settings to work.



Fixing Drop Alignment

Chapter 12

If the Mantis is dispensing drops that aren’t aligning with your plate drop locations, you may need to tune the Mantis's dispense location settings using the Drop Alignment Wizard and the reference plate.

In the instructions that follow, you will learn how to tune four points on the Mantis’s plate holder: A1, A12, H1, and H12. The Mantis then interpolates these locations to determine each remaining drop location on a plate.

Prerequisites

- You have the reference plate that was included in the Mantis accessory kit.
- You have either a Low Volume or High Volume chip.
- You have a pipette tip filled with colored water.

How to fix drop alignment:

1. Attach a chip to the Mantis's hand.
2. Place the pipette tip in the pipette tip input on the chip.

3. Prepare the reference plate. The reference plate has cross hairs located in every corner that can be used as reference points (see the picture below, indicated by four red circles).

4. Place the reference plate on the Mantis's plate holder. Use the **A1** location (indicated by the red circle) as the reference point.

5. Go to the **Tools** menu and select **Fix Drop Alignment**. The Drop Alignment wizard displays.

6. Follow the on-screen instructions.

System Maintenance

Chapter 13

Sterilizing Mantis Chips

You should sterilize the Mantis's chips if you are concerned about cross-contamination when using the same chip for different reagents, or if you are planning to leave the chip unused for more than 12 hours.

If your reagent is known to precipitate out shortly after a dispense, you should run the sterilization and wash cycle immediately following the dispense.

Acceptable sterilization solutions include:

- Low molar (~0.01N) NaOH
- 10% bleach, or
- 70% ethanol

Note: If you are using a wash solution in wash station 1, you are sterilizing the chips each time you wash with the wash solution followed by the water rinse and do not need to follow the instructions below. If you are using only water in wash stations, however, follow the steps below.

Sterilizing Mantis Chips

1. Empty wash station 1 and wash station 2. Fill the wash station 1 with one of the wash solutions listed above, and fill the wash station 2 with water.
2. Place the Mantis chips into the chip ports on the chip changer.
3. Click the **Input** button 

next to the each chip you plan to sterilize, and change the **Primary Wash Volume** to **100 µL** and the **Secondary Wash Volume** to **200 µL**.

4. Click the **Wash All Inputs** button  to wash the chips with the sterilization solution and rinse them with water.
5. Repeat step 4 two additional times, for a total of three wash/rinse cycles.
6. To dry the chips, click the **Recover All Inputs** button  .

Troubleshooting and FAQs

Chapter 14

Troubleshooting

While the Mantis is designed to be a reliable device, as with all hardware, problems may occur with use or over time. If you don't see your problem below, email support@formulatrix.com for assistance. Our technicians monitor this email address 24 hours a day, Monday through Friday.

The Mantis is not dispensing correctly -- drops are hanging at the end of the nozzle, dispenses are sporadic (i.e. the Mantis dispenses to every other well instead of every well), or the Mantis is not dispensing at all.

Sometimes the chips wear out. We recommend that you try dispensing with multiple chips. If the problem persists, contact support by emailing support@formulatrix.com. If you are on maintenance, you will be shipped a loaner Mantis, instructed to ship yours to support for repairs, and when you receive the repaired device you must ship back the loaner.

The Mantis is having trouble washing chips.

Usually this issue is caused by a misalignment of the wash position. To fix this problem, you will need to edit the sequence file. Contact support by emailing support@formulatrix.com and a support representative will walk you through the process.

My computer says the drive is read-only and I can't run the software.

If your computer is showing that the Mantis's USB drive is read-only, you will not be able to use the software because the software frequently writes to the USB drive. To fix this issue, copy the contents of the USB drive onto your computer, so that when you run the software you are running it locally instead of from the USB drive. Or if you are on maintenance, you can contact support by emailing support@formulatrix.com to get a replacement drive.

The Mantis is not showing up on my computer's drive list, or I can run the software but the software can't find the Mantis.

These problems are caused by USB communication issues. Please contact support by emailing support@formulatrix.com. If you are on maintenance, they will issue a loaner device to use while yours is repaired.

The Mantis is not picking up chips from the chip port, or it's picking up chips but not replacing them correctly.

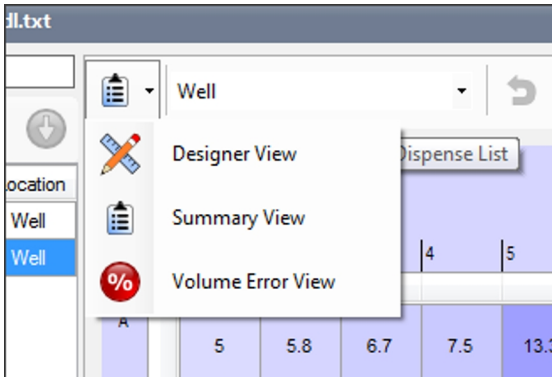
This issue can be fixed by calibrating the chip port positions.

The Mantis is dispensing drops, but the drops aren't aligned with the wells on my plate.

You need to fix the drop alignment settings. Go to the **Tools** menu and select **Fix Drop Alignment**, then follow the on-screen instructions.

The Mantis software seems frozen.

- If you are attempting to open or close the dispense design using a spreadsheet program such as Microsoft Excel, it can take a few moments for the software to translate your actions. Please be patient.
- Check that you are not in Summary View or Volume Error View. These two views will "freeze" the rest of the interface. Switch back to Designer View in order to enable the rest of the software's functionality. To change views, click the button at the top of the plate designer to display the alternative views.



The Mantis is dispensing incorrect volumes when using PFE/HV chips, or the Mantis is not dispensing accurately from a pipette tip.

Incorrect dispense volumes may occur if the chip type in use is different from the chip type selected in the Mantis software. Check that the chip type selected in the software is correct; if not, select the correct chip type. For more information, please see “Input Control Panel” page 25.

The Mantis can't aspirate reagents from a tube, or the Mantis can aspirate but the dispense volume is not accurate.

Check the tube connection and make sure it is firmly attached to the chip/tube input. If you see either if these issues after the first dispense or after the chip returns in between reagents, then make sure you are priming the chip before each dispense. Failure to prime a chip will prevent accurate dispenses. Please also note that it takes approximately 150-200 µL to prime the chip for the first dispense.

FAQs

If your question doesn't appear below, please email support@formulatrix.com and we will respond within 24 hours, Monday through Friday.

What should I do if the mantis software doesn't recognize the device?

Please take these steps:

1. Turn the Mantis device off.
2. Reconnect the USB cable on the Mantis's USB port to your computer. Make sure it is connected properly, and then restart the device.
3. Next, run the software; the indicator box should be green after it has detected the device.
4. If the problem persists, please check your hardware version and don't hesitate to contact Formulatrix support.

What viscosities or liquid classes can the Mantis dispense?

The Mantis can only dispense viscosities of Normal liquid class.

Accessories

Appendix A

Items	Description
Chips (Low Volume Chips, High Volume Chips, Low Volume PFE Chips, High Volume PFE Chips, High Volume CF Chips, Low Volume Molecular Grade chips, High Volume Molecular Grade Chips)	Four extra nozzles and tube adapters are included in the package. High Volume chips are indicated by a green input.
Chip Pallets	The chip pallets enable microfluidic chip replacement. Compatible with both low volume and high volume chips.
Mantis Chip Changers	The Mantis chip changers are used to hold chip pallets when not in use.
Extra Nozzles (LV And HV Nozzles)	The Mantis's nozzle is installed in the chip.
Abrasion-Resistant Teflon Input Tubing – Green (for High Volume Chips) and Clear (for Low Volume Chips)	The tubing is used for connecting ingredient(s) from its source to the chip(s).
Reference Plate	The reference plate is a clear plate that has crosshairs located at each corner. The crosshairs are targets for you to use if you need to tune drop position. The Mantis's software then determines the remaining drop positions from these four points.
Ball Point Hex Keys	It is also known as Allen wrenches, ball point hex keys are included for troubleshooting purposes.
Power Cable	The power cable is approximately 6 feet long, and is used to conduct power to your Mantis from the power supply adapter.

Items	Description
USB Cable	The USB cable connects the Mantis to a PC
Waste and Wash Tube	The waste tube is a container to remove spent washing fluid. The wash tube is a container to hold water or other washing solutions required for washing process.
Power Supply Adapter	The power supply adapter supplies power and connects to an electrical outlet and the Mantis power cable.
Food Coloring	Food coloring is included for test dispense purposes.

Index

A

Accessories ... 65
Adding a Dispense Delay ... 39
Adding Plate Types to the Plate Type Library ... 13
Adding Stock Reagents to the Reagent ... 18
Air Pump ... 24
Arms ... 9

C

Calibrating the Chip Port Positions ... 19
Check All Bottle Leak ... 26
Chip Changers ... 10
Cleaning the Chips ... 42
Computer Requirements ... 5
Configuring Mantis-Formulator Integration ... 56
Configuring Mantis-Rock Maker Integration ... 53

D

Designing a Dispense ... 35, 37
Device Control Buttons ... 23
Device Control Panel ... 22
Device View ... 27
Dimensions ... 5
Dispense List Buttons ... 28
Dispense List Designer ... 28
Dispense Setting Tab ... 23
Dispensing Formulator Plate Designs ... 44
Dispensing Rock Maker Plate Designs ... 43
Dispensing With the Mantis ... 35

E

Electrical Hazards ... 4
Electrical Requirements ... 6
Equipment Safety Guidelines ... 4
Executing a Plate Dispense ... 41

F

Fixing Drop Alignment ... 58

H

Hand ... 9
Hardware Overview ... 9

I

Initial Setup 12
Input Control Panel 25
Input Source Type 27
Input Toolbar 26

K

Key Features 7

L

LC3 Components 46, 49
Locating Plate 48

M

Mantis Components 9
Mantis Configuration 53
Mechanical Hazards 4
Multi-Plate Dispense 37

P

Plate Clamps 10, 24
Plate Designer 29
Plate Designer Toolbar Buttons 30
Plate Holder 10
Power Port 11
Power Switch 11
Prime
    Auto 25
    Manual 25
Prime All Inputs 26

R

Reagent Information Box 29
Recover All Inputs 26
Recover Input 26
Regulatory Compliance 3
Resolving Dispense List Errors 45

S

Setting Up the Hardware 32
Setting Up the LC3 for a Dispense 49
Setting Up the Mantis 12
Software Overview 20

Specifications 5, 6
Status Bar 30
Sterilizing Mantis Chips 60
Symbols and Conventions 2
System Maintenance 60

T

Total Volume ..... 21, 23, 29, *See also* Reagent Information Box
Troubleshooting and FAQs 62
Tuning the LC3 Carousel 51

U

USB Ports 11
Using Excel to Edit a Dispense Design 39

V

Valve Control Tab 24
Volume Fill Types 30

W

Wash All Inputs 26
Wash Input 26
Wash Stations 10
Waste Station 10
Weight 5