



**TipCharger™**  
**V20.06 User's Guide**

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IonField Systems  
One Executive Drive  
Suite 8  
Moorestown, NJ 08057  
Phone: +1.856.437.0330  
Fax: +1.856.823.1426  
Email: [info@ionfieldsystems.com](mailto:info@ionfieldsystems.com)  
[www.ionfieldsystems.com](http://www.ionfieldsystems.com)

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## Preface

### Limited Warranty

All TipCharger(s) and accessories sold by IonField Systems are under warranty against manufacturing defects in parts for the twelve (12) month period from the date of installation. For countries with longer warranty requirements, the variation will be noted on the documentation shipped with the instrument. If a customer elects to do a self-installation, the date the system is shipped to the customer starts the warranty period. The TipCharger will operate with the designated automated liquid handler to provide the service for which it is designed in accordance with IonField Systems published specifications.

IonField Systems disclaims all warranties, express or implied, other than those set forth in the published specifications or manufacturer's instructions for use. IonField Systems expressly disclaims any and all warranties of merchantability and/or fitness for any particular purpose.

### Important Cautions and Warnings

The TipCharger is designed for professional, commercial use only and is intended for use in the biopharmaceutical, agricultural, forensics, genomics and life science research laboratories. The TipCharger has not been approved for use with human samples in any process requiring FDA approval. Use of the TipCharger other than for its intended use or in any manner inconsistent with this User's Guide may cause personal injury, damage the TipCharger, affect its operability and constitute a breach of the applicable Agreement.

The TipCharger is designed to operate only with parts and supplies furnished or approved by IonField Systems. Other than the replaceable charcoal filter and vacuum tubing, the TipCharger has no user serviceable parts. All service must be provided by persons qualified and authorized by IonField Systems. Unauthorized modifications or repairs to the TipCharger and/or use of parts not supplied by IonField Systems may cause personal injury, damage the TipCharger, affect its operability and constitute a breach of the applicable agreement.

As with other electrical appliances, the TipCharger has specific electrical and environmental requirements. The requirements are set forth in this User's Guide. Use or operation of the TipCharger with different or fluctuating electric power or in environments not specified may cause personal injury, damage the TipCharger, affect its operability and constitute a breach of the warranty.

### Patent and Trademark Information

The TipCharger is protected by one or more of the following U.S. Patents: 6,724,608, 7,017,594, 7,094,314 and 7,367,344. Three additional patents have issued. Additional patents are pending.

Trademarks of property of IonField unless otherwise noted as property of others.

### Copyright Information

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## 1. Introduction

### TipCharger Technology

The TipCharger™ by IonField Systems™ is used for cleaning pipette tips specific to automated liquid handlers. The TipCharger's patented cleaning process is a carefully controlled energy transfer. Electrical energy generates room temperature plasma within the cleaning station. When pipette tips are inserted into the wells of the cleaning station, direct plasma exposure cleans the outside of the tips and the inside is cleaned by repeated aspirate and dispense cycles to bring the plasma to the inner surfaces. Organic molecules react with the oxygen in the plasma resulting in waste that is predominately CO<sub>2</sub> and H<sub>2</sub>O. The solvents volatilize and remain in the gas phase and are then safely vented away through an activated charcoal filter.

The TipCharger cleaning station produces what is commonly referred to as 'cold' or 'non-thermal' plasma. Most of the input energy is channeled to the electron component of the plasma while the resulting ions and neutral components remain at or near room temperature. The typical temperature difference between air inside the TipCharger Cleaning Station and outside is only 5 to 10 degrees Celsius. The TipCharger's plasma can be used with most metal, ceramic or disposable plastic tips.

The induction of atmospheric plasma begins with the discharge of free electrons from dielectric plates within the cleaning station. Through changes in polarity 6,000 to 8,000 times per second, electrons are forced to mobilize between a set of plates, resulting in an electron avalanche. The cascade of electrons converts molecules in air into plasma (molecules with disassociated electrons) and triggers the conversion of oxygen into singlet oxygen, high energy O<sub>2</sub> and ozone. The combination of organic molecules that have adsorbed significant energy in close proximity to an excess of highly reactive oxygen leads to the complete oxidation of anything organic.

The unique combination of free radical reactions and metastable atomic species formed within the Cleaning Station's cold-plasma field promotes the nearly instantaneous conversion, volatilization and ultimate removal of potential chemical or biological contaminants from pipetting surfaces. Furthermore, these species are readily pipetted in and out of cannulae, pin tools and disposable pipette tips when the opening of the tip is within the plasma field (Figure 1). This technique will actively cleanse the inner, wetted surfaces of the liquid transfer tools.

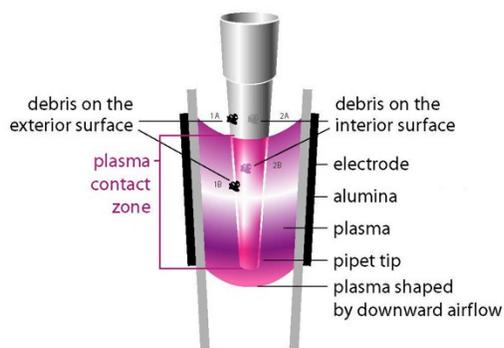


Figure 1. Plasma cleaning action in and around a pipette tip.

Plasma will flow easily into all microscopic surface imperfections and cavities, reducing tip-to-tip variations due to random surface properties.

## **Sterilization**

The term sterilization has multiple meanings with the medical meaning and scientific meaning being different. In general, sterilization refers to any process that effectively kills or eliminates transmissible agents, including fungi, bacteria, viruses, spore forms, and similar organisms. The term is not generally used to refer to the removal of prions. The most commonly used methods of medical sterilization are by the use of steam and ethylene gas; both are processes that kill but do not remove or clean. Plasma cleaning is a process that breaks down organic substances into CO<sub>2</sub>, H<sub>2</sub>O and other similar oxidative products and thereby will eliminate agents on the pipette tip being cleaned. Users have reported that common bacteria (E. coli, etc) and viruses are completely eliminated.

IonField Systems does not make a product claim of sterilization. The system has not been tested to be a general sterilization process although IonField Systems is not aware of any organism that has not been successfully eliminated when using the TipCharger for tip cleaning.

## 2. Safety of the TipCharger

The following symbols are displayed on product components.

### WARNING



- No operator serviceable components inside
- DO NOT REMOVE COVER
- Refer servicing to qualified personnel
- Power Cord provides main disconnect

### CAUTION



- RISK OF ELECTRIC SHOCK
- DISCONNECT THE POWER SOURCE BEFORE REMOVAL OR INSTALLATION OF THE HV CONNECTOR



- If the CE sticker appears on the back panel of the TipCharger, this product conforms to ENC Directive 89/336/EEC; EMC Specification EN 61326; and Safety Specification IEC 61010-1:2001 Second Edition



- Protective conductor terminal
- Do not remove the ground wire from the Cleaning Station.

In case of emergency, turn off power supply to the Controller Module by pressing the On/Off switch to the Off position.

When installing the system, position the Controller Module with appropriate ventilation clearances (1.25 cm on each side and 10 cm in front and rear). Position the Controller Module for easy access to the On/Off switch. Proper ventilation of the system through a hood or stack must be done prior to operation. The TipCharger should not be used in a sealed environment or in any environment where an enriched gas is present.

Position the Cleaning Station securely so that wires and cables are not inadvertently loosened. Do not remove the ground wire from the Cleaning Station.

### 3. TipCharger Components

#### Controller Module

The Controller Module (Figure 2) manages the system operation. It must be connected to a wall outlet (see *Specifications* for details based on country of use) and to the Cleaning Station. For proper ventilation, ensure that clearance for the Controller Module is 1.25 cm on each side and 10 cm on the front and back.

The User Interface consists of a keypad and alphanumeric display used to view operational as well as error conditions. The User Interface cable stows easily into the front panel of the Controller Module when not needed. The User Interface lifts off the controller by when pulled forward.



Figure 2: TipCharger Controller Module



Figure 3: Flash Drive Location under Keypad

A flash drive is supplied with the TipCharger. The flash drive is seated behind the User Interface on the Controller Module (Figure 3) and must be in place for the system to initialize. The flash drive captures data important to quality control and troubleshooting and should always be in place during system operation. Moving a flash drive or swapping flash drives from one unit to another may render both units inoperable. Please contact IonField Systems [Customer Support](#) before removing the flash drive.

Once the Controller Module is plugged in, and the On/Off switch set to the On position, the LED on the front panel of the User Interface will turn green when operating properly. If the LED turns red, the on board diagnostics are reporting a system problem and plasma will not be generated. Consult the *Troubleshooting* section of this User's Guide for additional information.

A vacuum pump contained within the Controller Module operates continuously while plasma is firing. If needed, it will automatically turn on during non-firing periods to regulate internal temperature. The operation of the pump is automatic and cannot be controlled by the user.

An activated charcoal filter is housed within a dropdown door on the Controller Module and collects byproducts formed during the cleaning process. It is important to replace the filter regularly. Refer to the instructions under *Replacing the Charcoal Filter* in section 7 for additional information.

It is recommended that the Controller Module be turned (i.e. flip the On/Off switch on the front of the Controller Module to the “O” position [Off]) during long periods of non-use (hours or days). The system should be turned on 15 minutes prior to use to allow the internal circuits in the Controller to thermally stabilize.

## Cleaning Station

TipCharger systems are available in the 8, 96 and 384-channel configurations (Figure 4). Plasma is generated in the Cleaning Stations when pipette tips enter the wells (Figure 5), triggering the optical sensor. A visible red light within the station indicates the sensor is activated. When tips are removed from the wells, plasma generation automatically ends. The vacuum pump will continue to run until the waste lines are cleared (usually about 10 seconds) and will automatically shut off unless cooling of the station is needed.



Figure 4: TC-8, 96 and 384 Cleaning Stations



Figure 5: Plasma generation within a TC-8

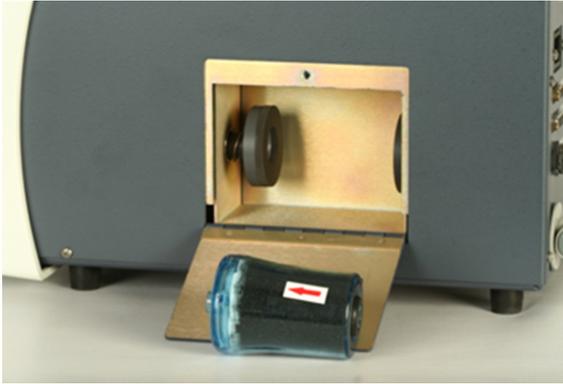
The high voltage connector and the communication cable will be attached to the Controller Module during the installation process. Always turn off the power before disconnecting either cable from the Controller Module. Refer to Figure 8 in *Section 4* for a visual identification of these cables.

## Cleaning Station Life Expectancy

IonField Systems has not identified a number of cycles that correlates to station life.

## Charcoal Filter

The plasma field is fully enclosed within a self-cleaning chamber. All by-products of the cleaning process pass through the TipCharger’s internal filtration system before either being vented to an external system or directly to the outside. The primary purpose of the charcoal filter is to protect the TipCharger hardware. The filter is housed inside a dropdown door on the side of the Controller Module (Figure 6).



*Figure 6: Charcoal filter and housing*

Proper ventilation through the hood or stack must be done prior to operation. Contact IonField Systems [Customer Support](#) for additional information.

### **Miscellaneous Parts**

The TipCharger systems are shipped with all required tubing and cables. Standard tube fittings will be provided at the time of installation. Fittings may include a 90° elbow to provide tubing routing flexibility from the Cleaning Station, a 90° connector for attaching umbilicals at the back of the Controller Module, and others as needed.

## 4. TipCharger Installation

### Connecting the System Components

Unless otherwise specified, the TipCharger should be installed by IonField Systems or one of its authorized field technicians. These instructions are provided for general information purposes or in the event the connections need to be re-routed.

**CAUTION!** Do not connect the Cleaning Station to the Controller Module until step # 5F. Do not plug the Controller Module into an outlet until step #8.

**1. Confirm that the filter is seated correctly.**

**2. Determine the correct position for the Cleaning Station on the deck.**

If the Cleaning Station is installed on a typical liquid handler platform, route the connector cables (braided HV cable, pneumatic hoses, and communication cables) in the front channel of the platform or under the elevated plate holders. Note: On Tecan EVO hardware, it is recommended that the platform side panels be removed before opening the front panel. Route the connector cables in the front channel before replacing the side panels.

Positioning, on platforms without channels for accessory devices can usually be achieved by placing the TipCharger along an edge of the platform work envelope. Contact IonField Systems [Customer Support](#) for additional suggestions regarding cable routing for specific hardware.

**3. Determine proper placement for Controller Module.**

Place the Controller Module on a nearby stable horizontal surface (e.g. nearby counter or floor under liquid handler platform) that will not impede ventilation. The HV cable is approximately 7' (2.13m) long and runs from the Cleaning Station to the rear panel of the Controller Module. It is recommended that a 0.5" (1.25cm) clearance be left on each side and 4.0" (10cm) in front and rear.

Position the unit for easy access to the On/Off switch and keypad located on the front panel.

**4. Install 90 ° elbows to the connector on Cleaning Station to prevent tubing from twisting or kinking if needed.**

Drape cables and use zip ties to keep them together. Ensure the vacuum hose is not crimped or twisted.

**5. Make connections to the rear panel of the Controller Module in the order described below. Refer to Figures 7 and 8 as guides to matching steps "A" through "F".**

**CAUTION!** DO NOT PLUG INTO WALL OUTLET and DO NOT TURN POWER "ON" at this time.



Figure 7: Back of Controller Module



Figure 8: Controller Connections

- A. Select the large diameter vacuum hose that comes packed in the brown box. Connect one of the plastic 90°connectors (from the same box) to the end of the hose and insert into the port labeled “exhaust”. Note: This port may be labeled “vacuum out” on some systems. Do not connect other end yet.
- B. Connect the other plastic 90°connector to the Quick Disconnect end of smaller diameter vacuum hose that comes packed in the brown box and insert into the port labeled “inlet”. Note: This port may be labeled “vacuum in” on some systems. Connect the other end to the similar connector on the Cleaning Station.
- C. Attach the 15 PIN communication cable extending from the Cleaning Station to port labeled “to Cleaning Station”.
- D. There is not current a connection to the port labeled “RS232” unless the TipCharger was purchased as a component of a system from an Authorized Integrator.
- E. Plug in AC cord (packed in the box labeled “System Components”). DO NOT CONNECT TO POWER SUPPLY.
- F. Plug in HV connector (factory connected to the Cleaning Station). Insert firmly into rear panel. Hand tighten the screws, and, if desired, use a screwdriver to make ½ turn tighter connections. **CAUTION: DO NOT TURN POWER “ON” AT THIS TIME.**

**6. Vent the exhaust hose from the port (Figure 9) through an external stack or hood.**

Venting the system is highly recommended and must be done prior to operation.



Figure 9: Exhaust port.

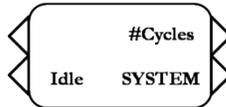
**7. Determine and teach the appropriate LiHa or array X, Y and Z coordinates.**

**8. Plug Controller Module AC cord into power supply. Turn ON/OFF switch on front panel to “1” (ON) position.**

**CAUTION:** Connecting the Controller Module to a power supply and turning the system ON prior to making all specified connections may damage the system, prevent plasma generation, or improperly filter debris and released gases.

**9. Verify successful initialization of system.**

- Keypad text will appear as:



- The green LED on the User Interface will be “on”.
- There will be a red glow from an optical sensor visible in the Cleaning Station.
- The cooling fan in the Controller Module will be operating.

**10. Test fire plasma to ensure proper operation.**

Using the keypad, press keys corresponding to “SYSTEM”, then “FIRE”, then “QUIT”.

- When plasma fires, the LED on the User Interface turns orange.
- There will be an even, purple glow visible within Cleaning Station wells. Cleaning Stations may require 15-30 seconds to light up all wells if the unit has not be used with the past hour.
- The Cleaning Station will audibly “hiss”.
- The Controller Module pump will run.

If any of these cues are not seen or heard, call [Customer Support](#) for assistance.

**Level Deck/Cleaning Station and related Platform Advice**

The TipCharger should be used only on the deck of the liquid handler that meets the original manufacturer’s specification for being flat and/or level. For the TipCharger Cleaning Station to function normally, tips must be lowered and raised in a true Z-axis movement only. Any offset in a non-cartesian axis, or a(n) X or Y-axis, may damage the ceramic plates used to generate the plasma or cause a number of operational problems with cleaning performance.

When defining the TipCharger in the liquid handler’s software, it is essential that an adequate clearance height be set to avoid tips colliding with the TipCharger. Please refer to the liquid handler documentation or supplier for guidance to ensure that adequate clearance is met. Speed of entry into and out of the Cleaning Station should be set to 50% maximum speed to eliminate any positional errors associated with high-speed movements.

Damage to the TipCharger Cleaning Station caused by the automation system used is not covered by the warranty.

Immediately cease using a liquid handler with the TipCharger if the deck of the liquid handler appears become un-level or is no longer flat. Contact the organization that services the liquid handler for assistance in correcting the situation.

## Spacers

The bottom plate of TipCharger cleaning stations conforms to the standards defined by the Society for Biomedical Screening (SBS). In the event that the plate holders used on the liquid handler conflict with the routing of cabling and vacuum tubes of the TipCharger, spacers can be supplied that will facilitate installation. If performing a self-install, please contact [Customer Support](#) to discuss your system's specific requirements before submitting a purchase order for a TipCharger.

## 5. User Interface

When the power is turned on, the LED on the front of the Controller Module (Figure 10a) will turn green and the User Interface will automatically initialize. Once initialized, the screen text on the main menu will appear as indicated in Figure 10b. The # Cycles will be a count of the number of times the system has been fired to date.

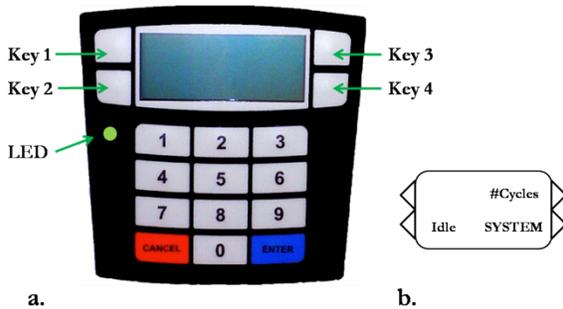


Figure 10: a. Controller Module Keypad. b. Example of screen display.

### Interface Keys

The four chevron keys are used to navigate through the user interface.

### System

When the LED on the controller has turned green, pushing the “SYSTEM” key will bring up a new screen with an option to fire the plasma accessed via key #1.

### FIRE

Selecting the FIRE key will result in generation of plasma. The plasma will automatically cease firing after 55 seconds.

### PLSM:x

The time elapsed during a cycle of plasma generation will be displayed in the PLSM:x position with the x being the elapsed time.

### Idle

When the cleaning station is not firing, the status of the unit will be displayed as “Idle”.

### Quit

Selecting the Quit key will stop the plasma generation in the cleaning station.

### SYSINFO

Specific system information is available by pressing the key next to SYSINFO. Use the ↓ or ↑ associated with keys 1 and 2 to scroll through the list, bringing the topic of interest to the top position.

Explanation	Screen Text	User Adjustable?
Controller Module serial # set at factory	SYS	N
ID of Cleaning Station set at factory	StaID	N
Firmware version (formatted as xx.xx.xx)	Ctl ver	N
Software version (formatted as xx.xx)	POD ver	N
Version set at factory	Hardware Ver	N
Number of plasma firing cycles for life of Controller Module; advances +1 with each firing of >6 seconds	Cycles	N
Permits contrast adjustment of User Interface screen	Backlight Adj	Y
Allows entry into support troubleshooting system; protected by security code provided by IonField Systems	CODE	N
A dynamic security code pertinent only to IonField Systems	RSetC	N
<b>Caution:</b> Contact <a href="#">Customer Support</a> before selecting – removal of flash drive will trigger system shutdown and require factory attention	USB Removal	Y

TipCharger Cleaning Stations will be taught as a piece of labware in the liquid handling software. The combined external and internal cleaning protocol can be inserted as a subroutine or subscript into other pre-existing software scripts.

## Error Messages

Hardware, software or connection errors are signaled in several ways:

- The LED on the User Interface will change to red.
- Plasma will not fire.
- An audible tone will sound. Turn off the alarm by using the On/Off switch on the front of the Controller Module.
- An error message will appear on the User Interface screen.

Contact IonField Systems [Customer Support](#) for assistance if experiencing any of the issues above. Note: Please call from a phone that allows easy access to the keypad and have the serial numbers from the Cleaning Station and Controller Module available.

## 6. System Optimization

### Plasma Generation

Plasma generation starts when an optical sensor is triggered as tips are inserted into the Cleaning Station. This “on” signal causes the processor to produce an electric field at the surface of the electrodes. The electric field creates a discharge between the electrodes, which ionizes the air around each tip. The energized air (i.e. the plasma) causes the breakdown of organic compounds at the molecular level. Plasma generation stops when tips exit the Cleaning Station. Application notes and white papers are available at [www.ionfieldsystems.com](http://www.ionfieldsystems.com) for additional information regarding plasma cleaning for specific applications.

The following key variables affect the optimal performance of the TipCharger:

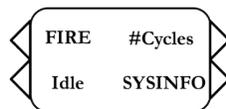
- Position of tips in the Cleaning Station
- Aspirate and dispense volume for interior cleaning
- Aspirate and dispense speed for interior cleaning
- The material to be cleaned (concentration, quantity, etc.)
- Number of cleaning cycles
- Frequency settings (factory set)
- Voltage level (factory set)
- Vacuum pump setting (factory set)

### Test Firing Plasma

To manually test fire plasma:

1. **Press key next to SYSTEM (key 4).**

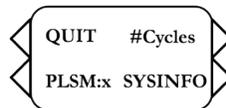
Screen text changes to:



The “# CYCLES” changes to a number that advances with each plasma firing cycle of >6 seconds associated with the Controller Module. Information about the SYS INFO is in the next section.

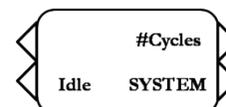
2. **Press key next to FIRE (key 1)**

Screen text changes to:



The TipCharger Control Module is factory set to turn off plasma generation after 55 seconds. To manually end plasma firing, press key next to QUIT (key 1).

Plasma stops firing and screen text changes to:



During plasma firing, the LED on the Controller Module turns orange. The LED returns to green after a cycle is complete. In most cases, pressing the orange CANCEL key on the keypad one or more times will bring back the main menu. Note: If the CANCEL key is pressed during a firing cycle, the plasma will stop firing.

### TipCharger Warm-up

It is recommended that the controller be turned on 15 minutes before use and that the system generate plasma for 2 minutes at a 50% duty cycle before processing the first sample (30 seconds on, 30 seconds off for 4 cycles).

### Deep Well 8 Channel Tip Positioning

The plasma field begins 9 mm from the top of the Cleaning Station and extends 10 mm. The figures below illustrate the proper position of tips for optimal cleaning. Figure 11 represents the optimal z-axis height for the aspirate / dispense routine to clean the inside of the tips. Figure 12 represents the maximum depth that tips can be lowered to for cleaning the outside of tips – 59 mm from the top of the Cleaning Station. The appropriate settings including LiHa moves for external cleaning will be determined at the time of the system installation.

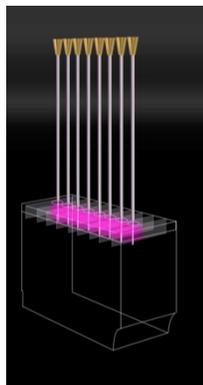


Figure 11: Start position.

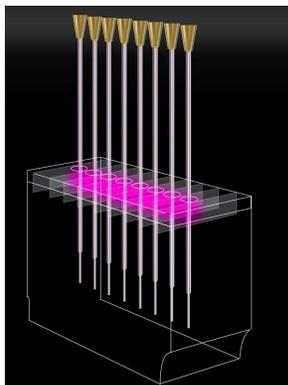


Figure 12: Finish position

A program with the recommended series of aspirate and dispense steps for optimal internal tip cleaning will be determined at the time of installation. Cleaning efficiency rates will vary depending on the type of contaminant, the concentration of contaminant and the volume of contaminant. It is recommended that plasma volumes equal to or greater than 2X the volume of contaminant be aspirated and dispensed during the cleaning cycle.

### 96 and 384 Tip Positioning

The 96 and 384 Cleaning Stations require only the setting of one depth of drop to achieve the proper position of tips for both interior and exterior cleaning. A program with the recommended series of aspirate and dispense steps for optimal internal tip cleaning will be determined at the time of installation. Cleaning efficiency rates will vary depending on the type of contaminant, the concentration of contaminant and the volume of contaminant. For optimal cleaning, it is recommended that plasma volumes equal to or greater than 2X the volume of contaminant be aspirated and dispensed during the cleaning cycle.

Note: As the available tip volume decreases, the percentage of the total volume of tip that is used in a transfer generally increases. It may not be possible to aspirate 2X the volume of contaminant when using some styles of tips. In this case, additional cleaning time may be required.

The Z drop of pipette tips into a TipCharger Cleaning Station is an important adjustment. The exact position to be used will vary based on the version of station and the brand/type of tip being used.

For the 8-channel station with metal probes, the approximate position to optimize around is 17-18 mm.

For the 96 station, the approximate position to optimize around is 17 -17.5 mm. When using plastic tips, the recommendation is to drop the tips less than 18 mm. When using higher volume tips (over 250  $\mu\text{L}$ ) start with a 15-16 mm drop.

For the 384 station, the approximate position to optimize around is 11- 13 mm. With small volume tips (20 or 30  $\mu\text{L}$ ), the recommendation is to drop the tips less than 14.5 mm.

The Z drop programmed into liquid handler software may not be accurately executed. Therefore it is recommended that the drop be precisely measured. The technique used by IonField personnel is to drop the tips into the cleaning station and score the side of the tip with a razor blade (or similar) at the top of the station. The tip is removed from the cleaning station and the distance from the end of the tip to the score mark is measured using a caliber. The setting to achieve the correct Z drop is then adjusted accordingly.

Tips with volumes over 100  $\mu\text{L}$  in the 96 channel configuration and over 20  $\mu\text{L}$  in the 384 configuration may not be able to be lowered to the optimal depth, reducing the area on the outside of the tip cleaned. In these cases, alternative steps may be suggested during installation to achieve optimal cleaning results.

The 384 Cleaning Station comes with a positioning tool to simplify establishing precise X Y and Z coordinates on the deck. This step of establishing precise coordinates is necessary on installation and when using a new tip type. Additional positioning tools can be ordered from IonField Systems if needed.

## Setting Plasma Aspirate and Dispense Rates

Under most usage conditions, the optimum aspirate and dispense rates for the tips in the cleaning station will be set to pull about one half the sample volume picked up by the tips per second. This will provide an aspirate dispense cycle every 3 - 4 seconds. For example, if 20  $\mu\text{L}$  of sample is pipetted, plasma will be aspirated and dispensed at 10  $\mu\text{L}$  per second.

As the sample volume aspirated increases, it may be necessary to slow the aspirate dispense cycle down so that the flow rate through the hole at the pipette tip does not propel droplets up the tip inner wall as an aerosol.

## Air Gaps

When working with non-aqueous solvents, it is important to pull and release air gaps at the right steps of the application. This will allow complete removal of the solvents from the tip. When using air gaps, equal consideration should be given to allowing some time (a few seconds pause) for any viscous liquid layer on the tips to flow to the tip before the air gap is expelled.

## DMSO Usage with TipCharger

In plasma, micro-droplets of DMSO (a polar aprotic solvent) are carried by the electric field from the tips to the surface of the ceramic plates forming an invisible, uniform layer. As the DMSO layer builds up, it suppresses the release of electrons, leading to plasma loss.

Contact [Customer Support](#) prior to using the TipCharger with pipette tips exposed to DMSO.

## Residual Material in Tips

When using material that is likely to contain aggregated material (e.g. blood, cell cultures, aggregated proteins, fermentation products) IonField Systems recommends a rapid pre-wash in water or appropriate solvent prior to using the TipCharger. Aggregated material will slow the plasma cleaning process and removal prior to cleaning improves liquid handling efficiency. A 5 to 10 second pre-wash is usually sufficient.

## Residual Droplets on Tips

For proper operation of the TipCharger Cleaning System, tips should be presented to the cleaning station without hanging drops or visible droplets on the tip walls. In normal operation, current liquid handlers deliver virtually 100% of the aspirated liquid to the intended destination well. However, some liquid tends to pool at the aperture of the pipette tip- typically 0.25 to 0.5% the volume pipetted with aqueous solutions and slightly higher with DMSO. The residual fluid is a thin layer of liquid, which will dissipate over time.

Removing as much excess fluid as possible prior to inserting tips into the TipCharger Cleaning Station is a key step for successful implementation of the plasma cleaning process.

In some systems that use liquid in the fluid lines and metal tips, there is an “over-fill” on aspiration built into the firmware. The system is programmed to break the fluid very precisely, based on flow rate when dispensed. This small slug of retained sample should be dispensed to waste before cleaning with TipCharger. At the conclusion of plasma cleaning, the system should be programmed to re-draw the air gap.

## Duration of Cleaning Cycle

The duration of the cleaning cycle will be affected by several factors, especially the type of material to clean from the tips. The maximum cycle time is 55 seconds. Multiple cycles can be used for contaminants that may be difficult to remove.

It is recommended that a 50% duty cycle, i.e. a 15 second cleaning cycle followed by 15 seconds not firing, be used for routine applications. If cooling is required, the LED on the User Interface turns red and the Controller Module pump speed will increase to full capacity until the Cleaning Station reaches its operating temperature. When the Cleaning Station is ready, the LED turns green again and another plasma firing cycle can begin.

Application notes with details regarding optimized cleaning times for various target molecules are available at [www.ionfieldsystems.com](http://www.ionfieldsystems.com).

## 7. Preventive Maintenance

### Cleaning Station Maintenance

IonField Systems recommends that Cleaning Stations be regularly inspected (about every 10,000 firings or every 6 months, whichever is the shorter period) by a trained IonField Systems engineer or authorized agent. In normal operation pipetting non-particulate containing liquids, a Cleaning Station should not need maintenance service more than once a year. Cleaning is performed as part of the standard Preventative Maintenance included in a system service agreement. However, if the pipetted liquids do contain particulate matter, it is recommended that the unit be inspected more frequently. Weekly inspections of the TipCharger cleaning stations may be required when used with some applications to ensure proper operation of the system.

Please note that TipCharger Cleaning Stations should only be serviced by trained and authorized agents. Users are advised not to disassemble Cleaning Stations and doing so may invalidate the warranty and lead to unsafe operation.

Cleaning Stations that have undergone a “flood” event or show excessive build-up upon routine inspection should be taken out of service immediately and serviced by IonField Systems or one of its authorized distributors. Please contact IonField Systems [Customer Support](#) prior to shipping any TipCharger Cleaning System or system component in for service.

### Solvents

The TipCharger Cleaning System is not recommended to be used with any sample solvent mix in which the primary solvent is anything other than water or DMSO and small volumes of alcohol (ethanol or methanol) or the ReCharger product from IonField Systems for rinsing the tips. The use of any other solvent or cleaning solution without the prior written approval from IonField Systems voids the product warranty and the user assumes full responsibility for any resultant damage to the TipCharger or laboratory.

### Replacing the Charcoal Filter

It is recommended that the charcoal filter be replaced every 3 months. To replace the charcoal filter:

- 1. Wear personal protective equipment during the replacement process (i.e. gloves and goggles).**

Be careful not to drop or bang the used filter. Loosen the screw on the dropdown door and grasp the old filter, pushing it to the left to release it from the stationary bracket.

- 2. Tilt the filter out to remove it from the enclosure.**

Ensure that the o-ring is attached to inlet of filter (Figure 13).

- 3. Follow corporate guidelines regarding disposal of like filters or materials.**

Insert the replacement filter by reversing the process listed above. New filters come with o-rings attached. Filters are directional; insert new filter with arrow pointing toward the front panel of the Controller Module, as indicated in Figure 13.

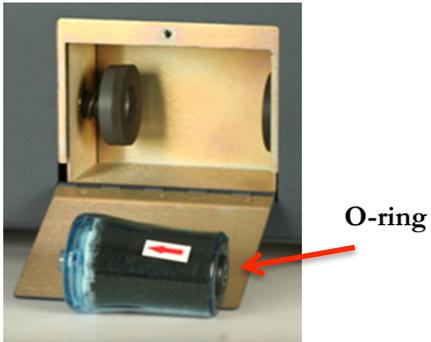


Figure 13- Charcoal Filter.

Order replacement filters from IonField Systems [Sales Support](#).

Use a dry, soft lint-free towel to clean the outside of the Controller Module and Cleaning Station. Do not use liquids to remove dust from the unit.

## 8. Troubleshooting

Refer to the tables below for guidance regarding possible issues and suggested resolutions. Please contact IonField Systems [Customer Support](#) if additional help is required. Please have the serial numbers of the Cleaning Station and Controller Module available at the time of the call. If contacting Customer Support by email, please include the serial numbers in the email.

### Tip Misalignment

Issue	Description
Cleaning Station is Moved or Dislodged	The Cleaning Station is moved or dislodged from its mounted position by motion of the pipette tips or the pipetting head.
<p><b>Suggested Resolution:</b></p> <p>Turn Controller Module off. Verify that the Cleaning Station is not damaged in terms of alignment. Replace it in the original deck position. Verify that X, Y and Z coordinates are properly set for TipCharger as well as surrounding positions.</p>	

Issue	Description
Robot Crash into Cleaning Station	During a Z-motion movement, the robot crashes into the Cleaning Station.
<p><b>Suggested Resolution:</b></p> <p>Turn Controller Module off. Verify that there is no serious damage to outer surfaces of the Cleaning Station, the robot arm or tips. Confirm that there are no alignment problems and that there is no unusual contact with the Cleaning Station.</p> <p>Re-initialize the liquid handler. Re-test the taught positions for TipCharger Labware. Make appropriate adjustments to verify there are no alignment issues.</p> <p>Do <u>not</u> attempt to insert tips misaligned from a robot crash or any other event. An attempt to do so will cause another crash, or friction from pressure applied by the tips may cause the Cleaning Station to pull off the deck or move out of position. These events could lead to a second robot crash on the next tip insertion.</p>	

Issue	Description
Robot Crash at Carrier Location other than Cleaning Station	During a Z motion movement, the robot crashes into another deck position – not into the Cleaning Station.
<p><b>Suggested Resolution:</b></p> <p>Turn Controller Module off. Verify using normal teaching methods that tips are aligning properly before they enter the Cleaning Station.</p> <p>Note: If tips are misaligned when entering the Cleaning Station, they will crash on attempting to enter wells or friction from pressure applied by tips may cause the Cleaning Station to pull up from the deck or move out of position, possibly leading to a robot crash on the next cycle.</p>	

## Fluid

Issue	Description
Fluid Spilled Around Cleaning Station	If fluid is spilled or dispensed at the outer surface of the Cleaning Station, it must be removed.
<b>Suggested Resolution:</b> Turn Controller Module off. Verify that little or no fluid has drained into the interior of the Cleaning Station. Lift the Cleaning Station off the deck position. Use a dry lint free cloth to wipe the surface of the Cleaning Station, the underside of the Cleaning Station and the surrounding robot deck position. Replace Cleaning Station in its position on deck.	

Issue	Description
Fluid Dispensed into Cleaning Station	If tips accidentally dispense liquids exceeding 100 nL per tip into the Cleaning Station, wells must be cleaned to ensure proper plasma generation.
<b>Suggested Resolution:</b> Turn Controller Module off. Verify that the liquid was actually dispensed. Contact <a href="#">Customer Support</a> for guidance in cleaning the interior wells. Do <u>not</u> attempt to clean the wells without calling Customer Support.	

## Operational

Issue	Description
Ozone Odor	Ozone should not be detected while standing close to Controller Module.
<b>Suggested Resolution:</b> Turn Controller Module off. Replace activated charcoal filter in the Controller.  Verify that exhaust tubing is connected and routed to a proper exhaust vent or fume hood.  Ensure all pneumatic tubing connections from the Controller Module to the Cleaning Station, and from exhaust to vent, are intact and not kinked or broken. Contact <a href="#">Sales Support</a> to order new tubing.	

Issue	Description
System Powers Down	The system appears to just stop (i.e. plasma will not fire).
<b>Suggested Resolutions:</b> Confirm circuit used by the Controller is operational. If the circuit is good and the LED is not on, contact <a href="#">Customer Support</a> .  Reboot the Controller Module (switch off, then on). If the User Interface LED is any color other than green, contact <a href="#">Customer Support</a> .	

Issue	Description
System Initialization Failure	An error message will be displayed if the system does not initialize when the power is on.
<p><b>Suggested Resolutions:</b>            All connections are not securely in place. Ensure that the power switch is turned on and the flash drive is securely seated. Ensure that all connections and plugs are securely in place.</p> <p>Reboot the Controller Module (switch off, then on).</p>	

Issue	Description
System Initialization Failure	The green light on the Controller Module does not come on when the unit is plugged in and the power switch is turned on.
<p><b>Suggested Resolution:</b>            All connections are not securely in place. Ensure that the power switch is turned on and the flash drive is securely seated. Ensure that all connections and plugs are securely in place.</p> <p>Reboot the Controller Module (switch off, then on).</p>	

Issue	Description
System appears non-operational	The system appears to be “off”.
<p><b>Suggested Resolution:</b>            Verify that the User Interface display and green LED are off.</p> <p>Verify that the exhaust fan on the back of the Controller Module is not blowing.</p> <p>Verify that the system is plugged into an operational wall outlet. For additional guidance, contact <a href="#">Customer Support</a></p>	

Issue	Description
TipCharger 8 Channel does not initialize	“Cover open” error message is displayed.
<p><b>Suggested Resolution:</b>            Contact <a href="#">Customer Support</a> as thermistor may be to be replaced.</p>	

Issue	Description
Plasma firing issue	Plasma does not fire when tips enter Cleaning Station.
<p><b>Suggested Resolution:</b></p> <p>Verify that Controller Module is on. Ensure tips are fully inserted to the appropriate Z position and are aligned to the center of the device. Verify that there is a red glow in the Cleaning Station (i.e. the optical sensor is working).</p> <p>Ensure the communication cable is firmly connected to the rear panel of the Controller Module (port labeled “to Cleaning Station”).</p> <p>Verify that the User Interface displays the main menu selections and that there are no error messages displayed.</p> <p>If the screen reads “waiting for communication with Controller”, or normal operation cannot be resolved, contact <a href="#">Customer Support</a>.</p>	

Issue	Description
Exhaust has an unusual or strange sound	If tubing to the Cleaning Station is kinked, the exhaust flow will be impacted..
<p><b>Suggested Resolution:</b></p> <p>Kinked tubing can cause a variety of operational issues. Use elbows and twist ties to keep hoses and cables as straight as possible.</p> <p>Straighten the tubing to the Cleaning Station, ensuring there are no kinks or twists. If the kinks are permanent, contact <a href="#">Sales Support</a> to order new tubing.</p> <p>Place Cleaning Station on the deck so all umbilicals can easily drape off deck.</p>	

Issue	Description
LOW FLOW WARNING Appears on User Interface Screen	<p>If tubing to the Cleaning Station is kinked, or a “Low Flow Warning” message appears on the User Interface screen, the tubing must be straightened.</p> <p>A blocked or clogged filter may also cause this problem.</p>
<p><b>Suggested Resolution:</b></p> <p>Kinked tubing can cause a variety of operational issues. Use elbows and twist ties to keep hoses and cables as straight as possible.</p> <p>Place Cleaning Station on deck so all umbilicals can easily drape off deck.</p> <p>To assess whether the filter is causing the reading, remove the filter (see instructions in this Guide) and run the system without the filter. If the warning disappears, replace the filter and reboot the system.</p>	

## Cleaning Performance

Issue	Description
Tips are not clean after a cleaning cycle	Tip position, pretreatment, or application selection is not optimal.
<p><b>Suggested Resolution:</b></p> <p>Confirm that changes have not been introduced to the physical set-up or the software commands for the liquid handler system.</p> <p>Ensure all directions included in User's Guide <i>System Optimization</i> section are followed. Contact <a href="#">Customer Support</a> for applications support.</p>	

Issue	Description
Plasma doesn't fire evenly  Cleaning performance has degraded	Some Cleaning Station wells have a single filament in the center during a plasma firing.  When looking into the Cleaning Station during a plasma firing, there is no plasma in the center, but there is some plasma at the edge of the field.
<p><b>Suggested Resolution:</b></p> <p>Kinked tubing can cause a variety of operational issues. Use elbows and twist ties to keep hoses and cables as straight as possible.</p> <p>Straighten the tubing to the Cleaning Station, ensuring there are no kinks or twists. If the kinks are permanent, contact <a href="#">Sales Support</a> to order new tubing.</p> <p>It is also possible that wells in the Cleaning Station have been contaminated. Contact <a href="#">Customer Support</a> for additional guidance regarding well cleaning.</p>	

## 9. Specifications

### Physical Specifications

#### TipCharger Controller Module:

- Height: 30.5 cm (12")
- Width: 25.4 cm (10.0")
- Length: 40.6 cm (16.0")
- Weight: 14.1 kg (31.1 lbs)

#### TipCharger Cleaning Station:

- The Version 2 Base conforms to SBS standard microplate footprint (1-, 3- and 4-2004)

#### Cleaning Stations with the Version 1 Base Plate

- Height: 8 Channel - 3.15" (8.0 cm), 96 and 384 channel – 1.375" (3.4925 cm)
- Width: at widest point 3.75" (9.5 cm), at base 3.37" (8.5 cm)
- Length: 5.03" (12.8 cm)

#### Cleaning Stations with the Version 2 Base Plate (shipped with all systems as of Feb 2011)

- Height: 8 Channel – 82.00 +/- 0.5 mm
- Height: 96 and 384 - 38.50 +/- 0.5 mm
- Base (all Stations) – 85.48 +/- 0.5 mm by 127.76 +/- 0.5 mm
- Top of 96/384 Stations – 92.00 +/- 0.5 mm by 145.00 +/- 0.5 mm
- Weight: 1.5 lbs (0.68 kg) without 7' (2.13 m) cable and vacuum interconnects to the Controller Module (note that cable interconnects are permanently attached)



Do not disassemble Cleaning Station. Do not remove cover from Cleaning Station. See Preventive Maintenance section of this User's Guide. Should the Cleaning Station become damaged do not use. Refer servicing only to authorized personnel.



Do not disassemble Controller Module. Do not remove cover from Controller Module. There are not any spare parts other than the filter. See Preventive Maintenance section of this User's Guide. Refer servicing only to authorized personnel.

### Environmental Specifications

- Indoor use only
- Altitude up to 2,134 m

- Operating Temperature: 5°C to 32°C
- Relative Humidity: 30-80%
- Exhaust connection: 6.1 m, 1.27 cm ID silicone tubing
- Clearance around Controller Module: 1.25 cm on side and 10 cm on front and rear
- Pollution degree: 2
- Degree of protection: IP20H (IEC 60529)
- Exhaust Gas: Ozone, less than 10 ppm @ maximum flow of 100 l/min (3.5 ft<sup>3</sup>/min)
- Sound Pressure Level: Less than 75 dB A-weighted at 0.91 m distance (IEC 61672:2003) – measured with a TC-8 configuration.



Clean TipCharger components using a dry soft lint-free towel. Do not use liquids to clean. If liquids are spilled into Cleaning Station, follow recommended guidelines from Customer Support.

### Electrical Supply Requirements

- Power connection IEC 950-compliant.
- For user protection, equipment has passive and active interlock system. Do not defeat.
- Normal operating voltage: 900V-1400V RMS (Maximum experience 2.1kV RMS)
- Does not use a universal power supply. Each system is configured specific to the power service of the place of use. Movement to a different country requires reconfiguring at the factory. Power selection options are:

Model	Fuse: Amp/Type/Voltage	Service Voltage	Hz	Watts
US	5A / Fast Blow / 250V	110 - 124	50 - 60	360
EU	2.5A / Fast Blow / 250V	220 - 240	50 – 60	360



DANGER: High voltage present. 1.4 Kv Rms present at electrodes. Shock hazard is present. Do not touch the electrodes or apply mechanical force to its surface



In case of emergency, turn off power supply to the Controller by pressing the On/Off switch to the Off position.

## Compliance with Recognized Standards

- Safety: EN-61010
- Emission Standard: EN-61326 Class 2; FCC Part 18; ICES-001
- ENC Directive 89/336/EEC
- Product is produced in an ISO 9001:2000 production facility as certified by TUV America, Inc.
- TipCharger Cleaning Systems are manufactured in the USA.

## 8 - Channel TipCharger

TipChargers other than the 8-channel configuration conform to the SBS standard. 8-Channel configuration specifications include:

- Cleans up to 8 tips simultaneously
- Tip centerlines at 9 mm
- Centerline to centerline variation +/- 1.5 mm, +/- 2.5 mm cumulative
- Polypropylene tips: up to 200  $\mu$ L capacity and 4mm maximum outer diameter at 20 mm from the tip
- Metal tips: maximum outer diameter 2 mm
- Maximum external length cleaned: 50 mm

The TipCharger is not suitable for use with conductive plastic or Teflon-coated tips.