Dimatix Materials Printer
DMP-2800 Series
User Manual

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Important Safety Information

Symbols *(Symbole)*

WARNING

This symbol identifies information about procedures, practices or conditions that can result in damage to the product, economic loss, personal injury, or death.
(Dieses Symbol kennzeichnet Hinweise zu Handlungsweisen, Methoden oder Zuständen die zu Schäden am Produkt, wirtschftlichem Verlußt, Personenschäden oder zum Tode führen können.)

CAUTION

This symbol identifies information about practices or circumstances that may lead to damage to the product or other economic loss.
(Dieses Symbol kennzeichnet Hinweise zu Handlungsweisen oder Sachverhalten die zu Schäden am Produkt oder anderen wirtschaftlichen Schäden führen können.)

This symbol identifies where there may be risk of damage to the product due to Electrostatic Discharge.
(Dieses Symbol kennzeichnet Stellen an denen das Produkt durch elektrostatische Entladung beschädigt werden könnte.)

ESD Advisory
ESD = Electrostatic Sensitive Device
(*EGB = elektrostatisch gefährdetes Bauteil*)

IMPORTANT

This symbol identifies information that is essential to the understanding and correct use of this product.
(Dieses Symbol kennzeichnet, für das Verständnis und den richtigen Umgang mit dem Gerät, wesentliche Hinweise.)

Warnings *(Warnung)*

IMPORTANT

All moving parts are interlocked to the printer lid. The machine will stop if the lid is lifted during operation.
(Alle beweglichen Teile sind mit der Drucker Klappe gekoppelt. Die Maschine bleibt stehen wenn die Klappe im Betrieb geöffnet wird.)

Safety *(Sicherheit)*

Only qualified, service-trained personnel who are aware of the hazards involved should perform calibration, maintenance, or repair of the product. Only these qualified personnel should remove the covers from the product.
(Kalibrierungen, Wartungen oder Reparaturen am Produkt sollten nur von qualifiziertem Servicepersonal, das sich den bestehenden Gefahren bewusst ist, vorgenommen werden. Nur qualifizierte Servicepersonal sollte die Abdeckungen am Produkt entfernen.)

For continued protection against fire, replace the line fuses only with fuses of the specified type and rating.
(Ersetzen Sie die Eingangssicherung nur mit Sicherungen des spezifizierten Typs und der spezifizierten Leistung, um einen sicheren Betrieb zu gewährleisten und Bränden vorzubeugen.)

Modification or misuse of the product or components can cause harm to the user and will void any warranty.
(Veränderungen oder Missbrauch des Produkts, oder Veränderungen oder Missbrauch von Komponenten können den Benutzer oder Dritte schädigen und führen zum Garantieverlußt.)

The product must be connected to a protective earth conductor via the three-wire power cable. The power plug shall be inserted only into a grounded outlet. Do not defeat the protective action by using an extension cord without a grounded conductor.
(Das Produkt muß durch den Betrieb mit einem dreiadrigen Stromkabel geerdet werden. Der Stecker darf nur in eine geerdete Steckdose gesteckt werden. Benutzten sie nur dreiadrige Verlängerungskabel mit Erdung.)

Fluid used in this product must have a fire point greater than 125° C.
(Flussigkeiten die in diesem Produkt eingesetzt werden müssen einen Flammpunkt grösser 125°C haben.)

Do not operate the product in an explosive atmosphere. Do not operate the product in the presence of inflammable gases or fumes. Operation of any electrical instrument in such an environment clearly constitutes a safety hazard.
(Benutzten sie das Gerät nicht in explosiver Atmosphäre. Benutzen sie das Gerät nicht in der Nähe von entflammbaren Gasen oder Dämpfen. Der Einsatz jeglicher elektronischer Geräte in einer solchen Umgebung stellt eine eindeutige Sicherheitsgefährdung dar.)

WARNING

Care must be used when jetting multiple fluids. It may be possible for reactions to occur in the absorbent pads where multiple and or incompatible fluids may come in contact with each other.
(Vorsicht ist beim Umgang und Druck mehrerer verschiedener Flüssigkeiten geboten. Es ist möglich, dass Reaktionen in den Absorberkissen stattfinden, wo inkompatible Flüssigkeiten miteinander in Kontakt geraten können.)

WARNING

The platen can reach temperatures of 60° C which is hot to the touch. It can melt some materials if placed on it while hot, and it can cause volatile materials to evaporate faster if placed on the platen when hot.
(Die Substratplatte kann Temperaturen von bis zu 60°C erreichen. Dies ist zu heiss, um sie zu berühren. Diese Temperatur kann Materialien zum schmelzen bringen, wenn diese auf die Platte gestellt werden. Ausserdem verdampfen flüchtige Materialien schneller wenn sie auf die heisse Platte gestellt werden.)

WARNING

The cartridge can reach temperatures of 70°C which is hot to the touch, and it can cause volatile materials to boil off faster. Care must be taken that the cartridge settings are appropriate when installing a cartridge with volatile fluids.
(Das Cartridge kann Temperaturen von bis zu 70°C erreichen. Dies ist zu heiss, um es zu berühren. Ausserdem verdampfen flüchtige Materialien schneller wenn sie das heisse Cartridge berühren. Die Cartridge Einstellungen müssen sehr sorgfältig gewählt werden, wenn mit leicht flüchtigen Materialien im Cartridge gearbeitet wird.)

IMPORTANT

Replaceable pads capture and hold virtually all ink jetted into them. In many cases this may then be considered "solid waste" rather than "liquid waste." Please dispose of properly.
(Die austauschbaren Absorberkissen können fast alle Tinten aufnehmen. In vielen Fällen gilt dies ehr als „Fester Abfall" und nicht als „Flüssigkeits Abfall". Bitte entsorgen sie diesen fachgerecht.)

IMPORTANT

This product complies with INSTALLATION CATEGORY II and POLLUTION DEGREE 2 in IEC61010-1. This product is an INDOOR USE product.
(Dieses Produkt erfüllt die Forderungen der „Installation Category II" und „Pollution Degree 2" nach IEC61010-1. Dieses Produkt ist ein Produkt für den Gebrauch in trockenen Räumen.)

IMPORTANT

The LEDs within this product are Class 1 in accordance with IEC60825-1, CLASS 1 LED PRODUCT.
(Die LEDs in diesem Produkt sind Class 1 nach IEC60825-1, Class 1 LED Product.)

Do not dispose this product as unsorted municipal waste. Collection of such waste separately for special treatment is necessary.
(Entsorgen sie dieses Produkt nicht als unsortierten Hausmüll. Eine fachgerechte Entsorgung ist nötig.)

Note: This equipment has been tested and complies with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at one's own expense.

This product complies with the radio interference requirements of the European Union.

System Description

The Dimatix Materials Printer, or DMP, is a laboratory and limited production tool that enables researchers, scientists, and engineers to evaluate the use of ink jetting technology for new manufacturing and analytical processes. It is designed to be convenient and easy to use to carry out "proof of concept" and development work using ink jet technology. It does have extensive capabilities to allow increased experimental sophistication to optimize process parameters for the user's applications as the user gains familiarity with the system.

- Sheet substrate scanning "ink jet" deposition system with drop observation, spot location, and variable printing resolution
- Low cost, user-fillable piezo-based jetting cartridges:
  - Fluid module with syringe filling system
  - 16 nozzles at 254 µm spacing
  - 10 picoliter drop size with multi-burst capability
- PC-controlled operation, including visual monitoring of ink jetting and printed pattern inspection

System Accessories

- Personal Computer (supplied)
  - 2.4 GHz CPU minimum
  - Two available USB 2.0 ports on computer (shows up as "Standard Enhanced PCI to USB Host Controller" in device manager). 1280 x 1024 screen resolution
  - 512 MB dram minimum
  - At least 200 MB free disk space
  - Windows XP operating system with Service Pack 2 installed
- Starter Kit – consists of (1) DMC-11610 cartridge, (1) 30 ml bottle of model fluid, (1) fill tip, (10) cleaning pads, (1) drop watcher pad, (1) filter and (1) syringe
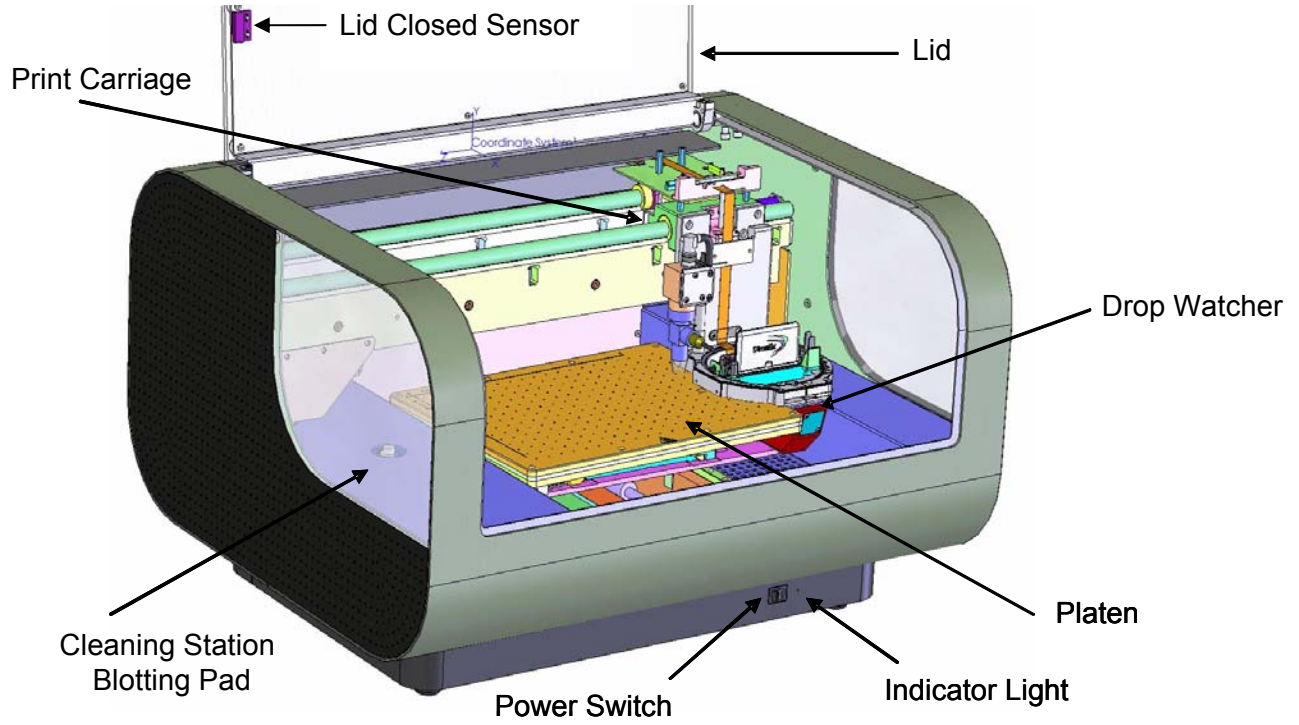- Syringes
- Filters
- Fill tips

- Drop watcher pads

- Cleaning pads

- Substrate location and positioning system (fiducial camera system)
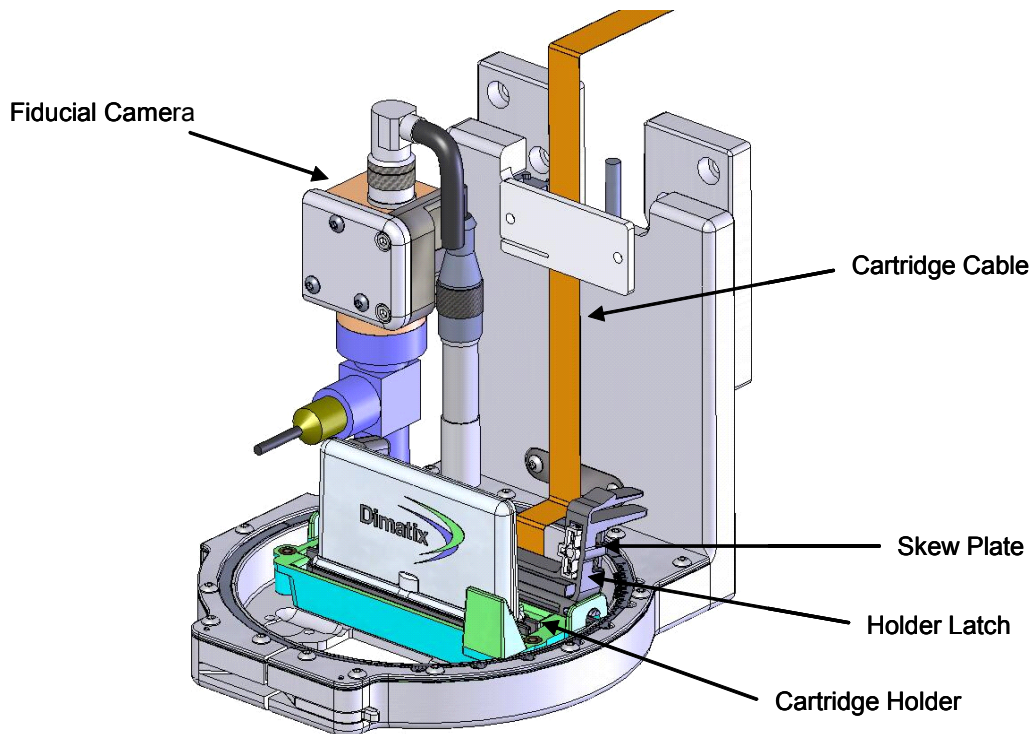
System Requirements

- Power: 100-120 / 200-240 VAC 50/60Hz 375W maximum

- Environment: It is recommended that the DMP be used in a reasonably controlled temperature and humidity environment to aid in uniform test results. Atmospheric conditions can affect the materials used in jetting trials.

  o Operating:

    – Temperature range 15 to 40°C

    – Humidity range 5-95% RH, non-condensing

System Identification

Dimatix Materials Printer

Lid Closed Sensor

Lid

Print Carriage

Drop Watcher

Cleaning Station
Blotting Pad

Platen

Power Switch

Indicator Light

Print Carriage

Fiducial Camera

Cartridge Cable

Skew Plate

Holder Latch

Cartridge Holder

Set-Up and Installation

Unpacking

DMP

- The DMP is shipped in a wood crate

- The DMP weighs approximately 45 kg (100 lbs). It is required that a minimum of two people lift it out of the crate and place it onto a surface sturdy enough to support it without excessive vibrations or oscillations. *Be careful not to put fingers into fan covers on the DMP bottom when lifting.*

- Remove items from box
  - Starter Kit
  - Cartridges
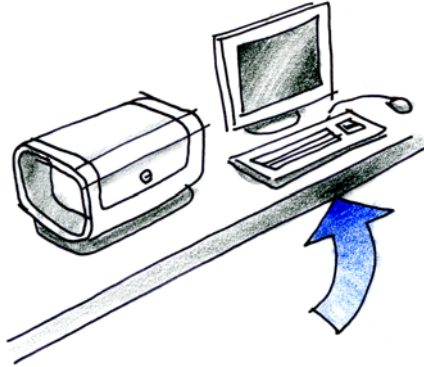 - User Manual
  - Cables
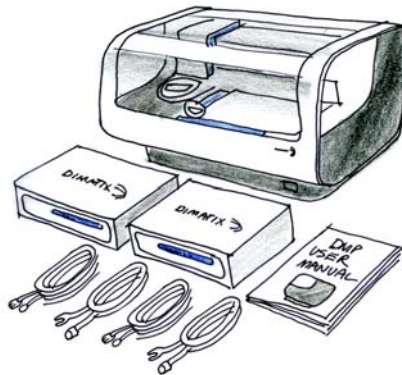
- Verify contents with checklist

- Place DMP on an appropriate surface

- Remove shrink wrap from DMP

- Free items that have been secured for shipping
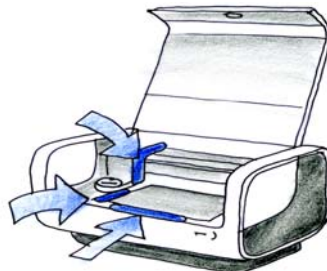
1. Remove foam under carriage assembly

2. Remove foam from front and side of platen

PC

- The PC system is shipped in its original boxes
- Remove them from their boxes and set them next to the DMP

- Check back of the DMP for USB, S-video, and power connections. Identify appropriate cables.
- Connect all cables
  - o Power cables to DMP, PC and monitor
  - o USB cable from PC to DMP
  - o S-video cable from DMP to PC
  - o Monitor video cable to PC
 - o Keyboard and mouse cables
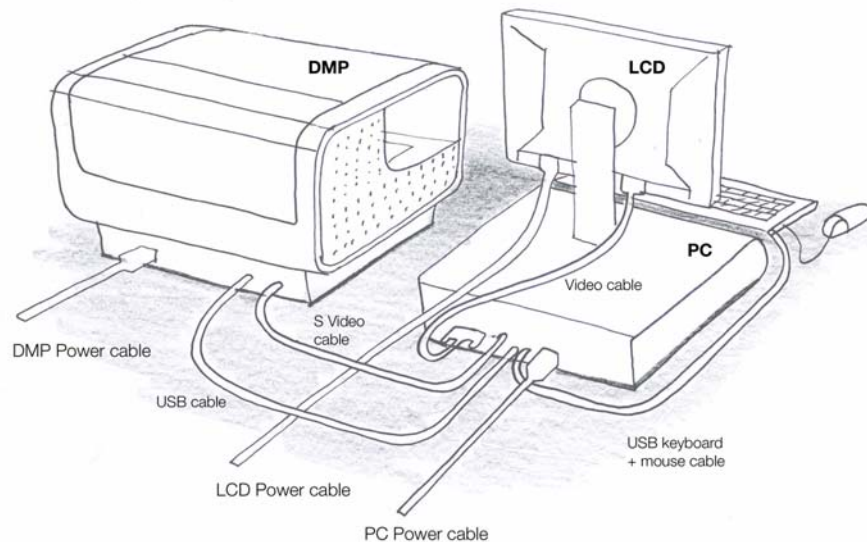
- Turn on power to PC
  - o Allow PC to go through complete start up
- **Note:** Do not change the Regional Settings in the Windows XP Operating System. The software will not operate properly. Do not connect DMP to PC through a USB hub. Do not use video or USB cables longer than 2 meters. Note the air flow pattern if you need to consider ventilation.
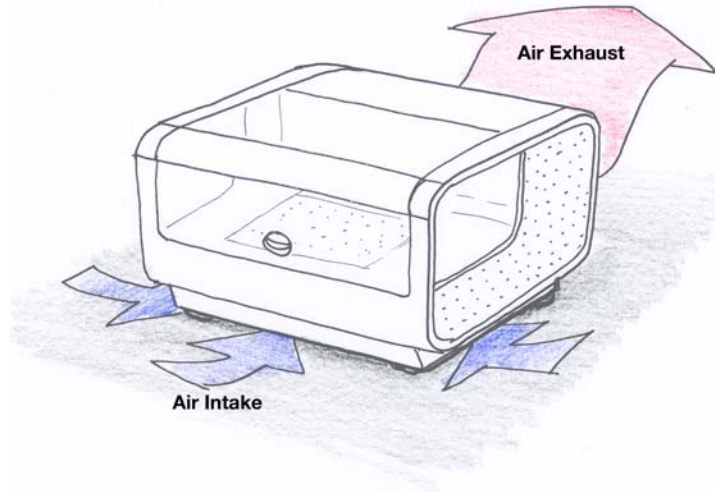
Starting Your DMP

- Make sure DMP lid is closed and all shipping foam is removed
- Turn on power to DMP
  - o The light next to the power switch should go on
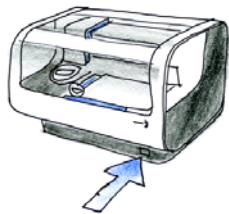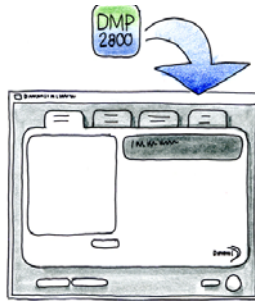

  - o Wait at least 5 seconds

Run Application

- The **DMP 2800** icon is on the PC desktop. Select the **DMP 2800** icon on the screen.

Dimatix Drop Manager

- Double click to initiate the Dimatix Drop Manager application.

- After initiating the program, click **OK** to allow the DMP to run through its initialization sequence.


Start-Up Operation

Screen Descriptions

The following screen **Printer Configuration Information** can be located in the **Help** tab on the **Dimatix Drop Manager (DDM)** window. It provides information regarding the version on the DMP, its software, as well as actual cartridge and platen temperature and nozzle meniscus pressure. This information is helpful later if you want to verify those parameters during operation of the DMP.

The information in the following image is only for example purposes and may not match the information for your DMP.
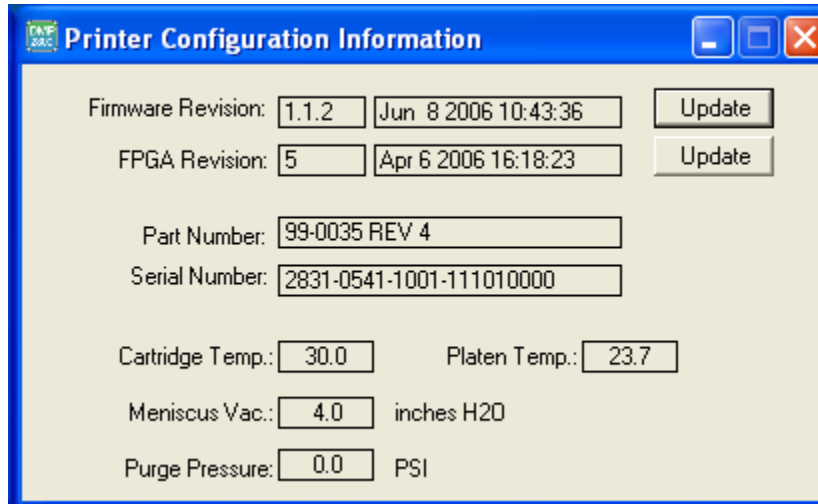
An additional program feature is a link to the FUJIFILM Dimatix Web site. If your PC is connected to the internet, click on the Dimatix logo on the bottom right of the various DDM screens to automatically connect to the Web site.

Install Cartridge
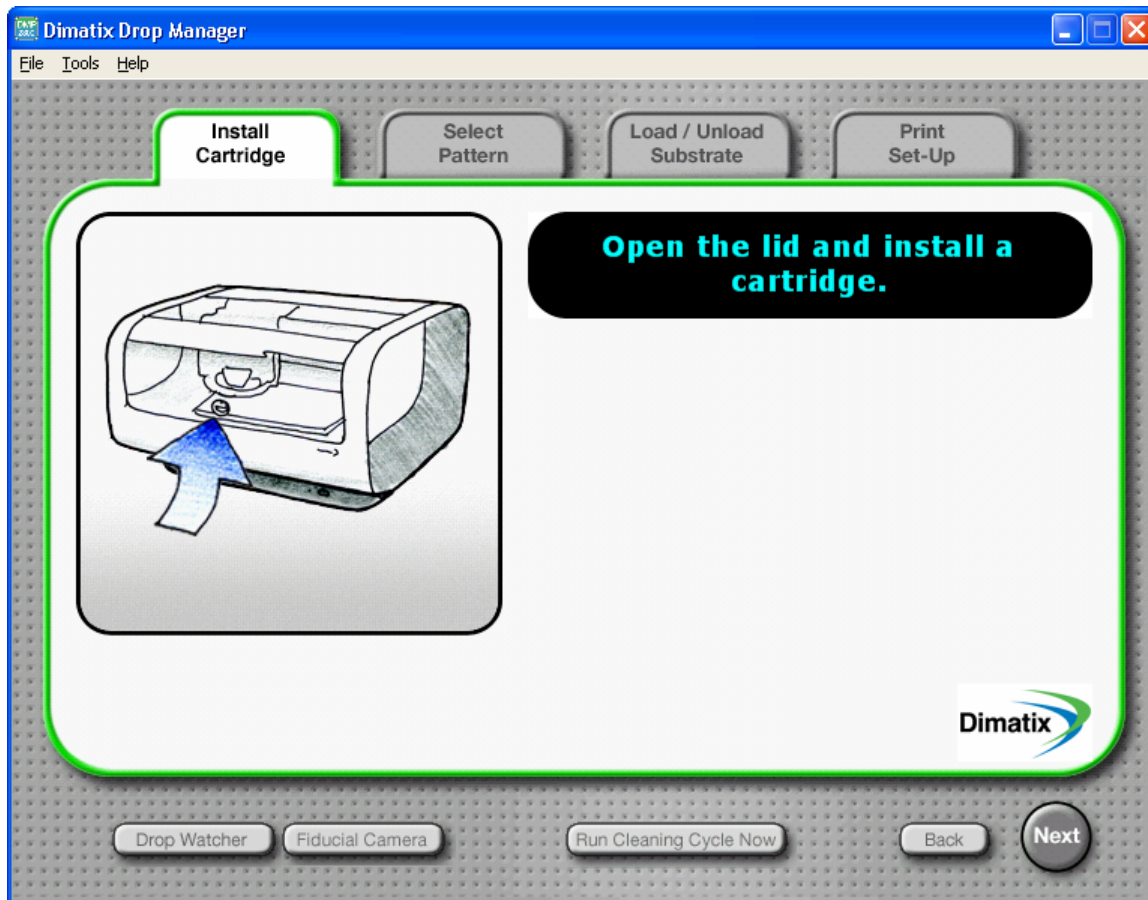
- Prepare the **Dimatix Model Fluid Cartridge** from the Starter Kit. *See Cartridge Filling instructions.*
- Lift the DMP lid all the way open.
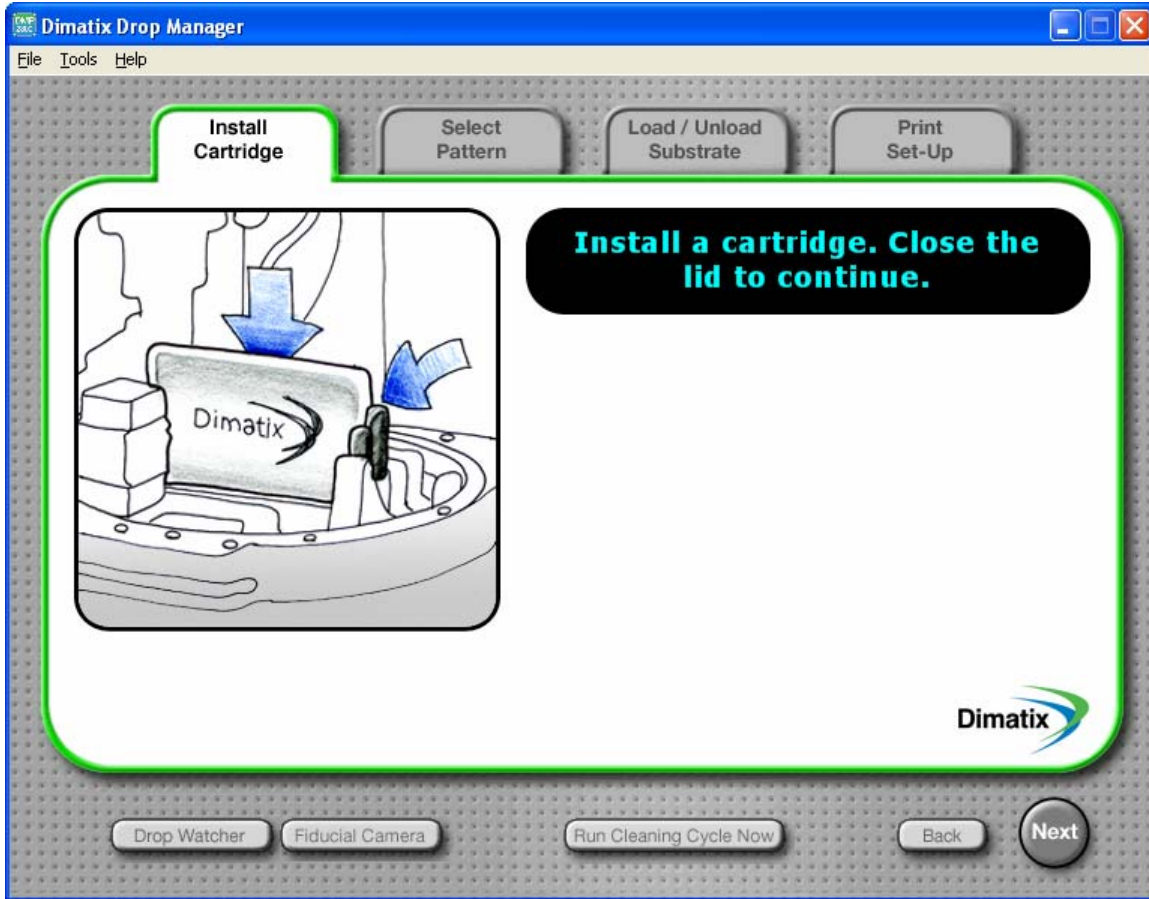
- Insert the cartridge into the cartridge holder on the carriage with the electrical connection pads towards the back of the machine matching the connector of the holder. There is only one way it will fit. Push it down firmly so that it "clicks" into place.
- Pull the cartridge holder latch forward and down until it locks in place. You will hear a click. Check to see that the cartridge is sitting flat in the holder.
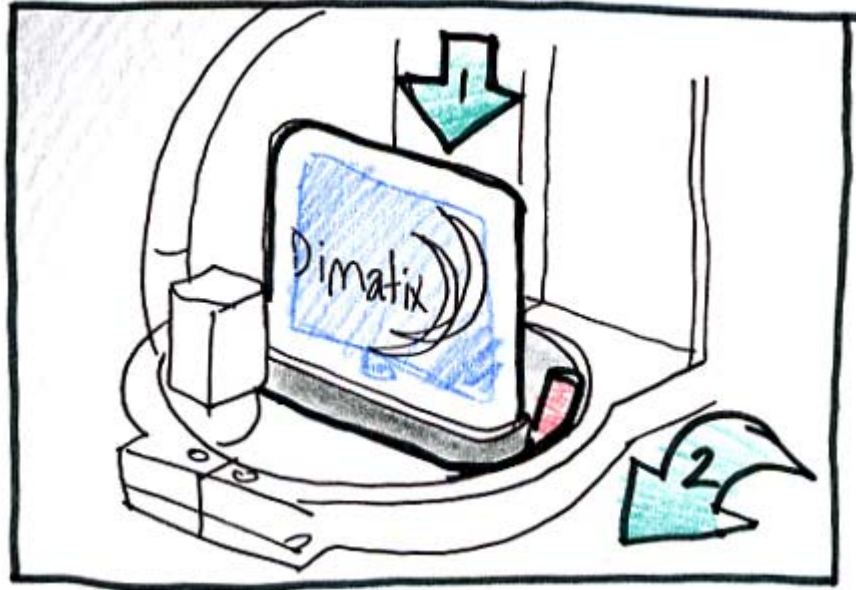
- After the cartridge is installed, close the lid. You should hear a pump turn on to control the meniscus pressure.
- The following window will pop-up.
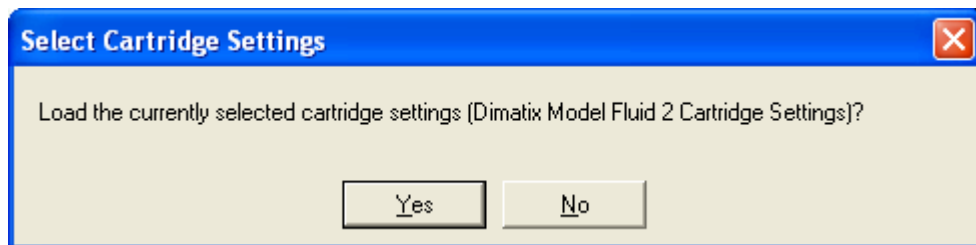
- Click **Yes** to load the settings for Dimatix Model Fluid 2.
- After clicking **Yes**, the screen will advance to the **Select Pattern Screen**.

Select Pattern
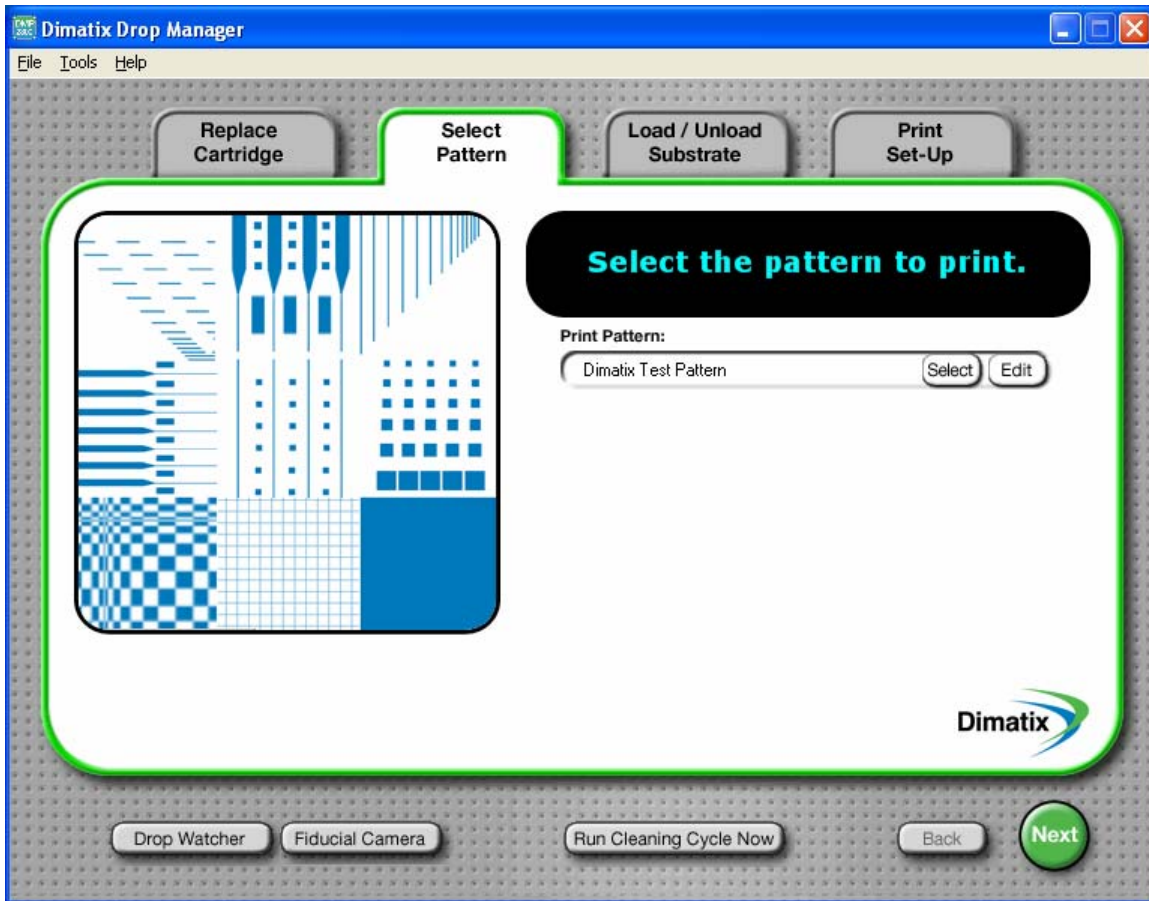
- The Dimatix test pattern will be auto-selected. This is a general use pattern which will let you see that the system is operating correctly.
- Click on the **Next** button to proceed.
- This takes you to the **Load/Unload substrate** screen.

Load/Unload Substrate

- On this screen you control the platen temperature and vacuum. You also must enter the thickness of the substrate you are going to use. To start, use the enclosed piece of glossy ink jet paper to run the test pattern. This paper is about 250 m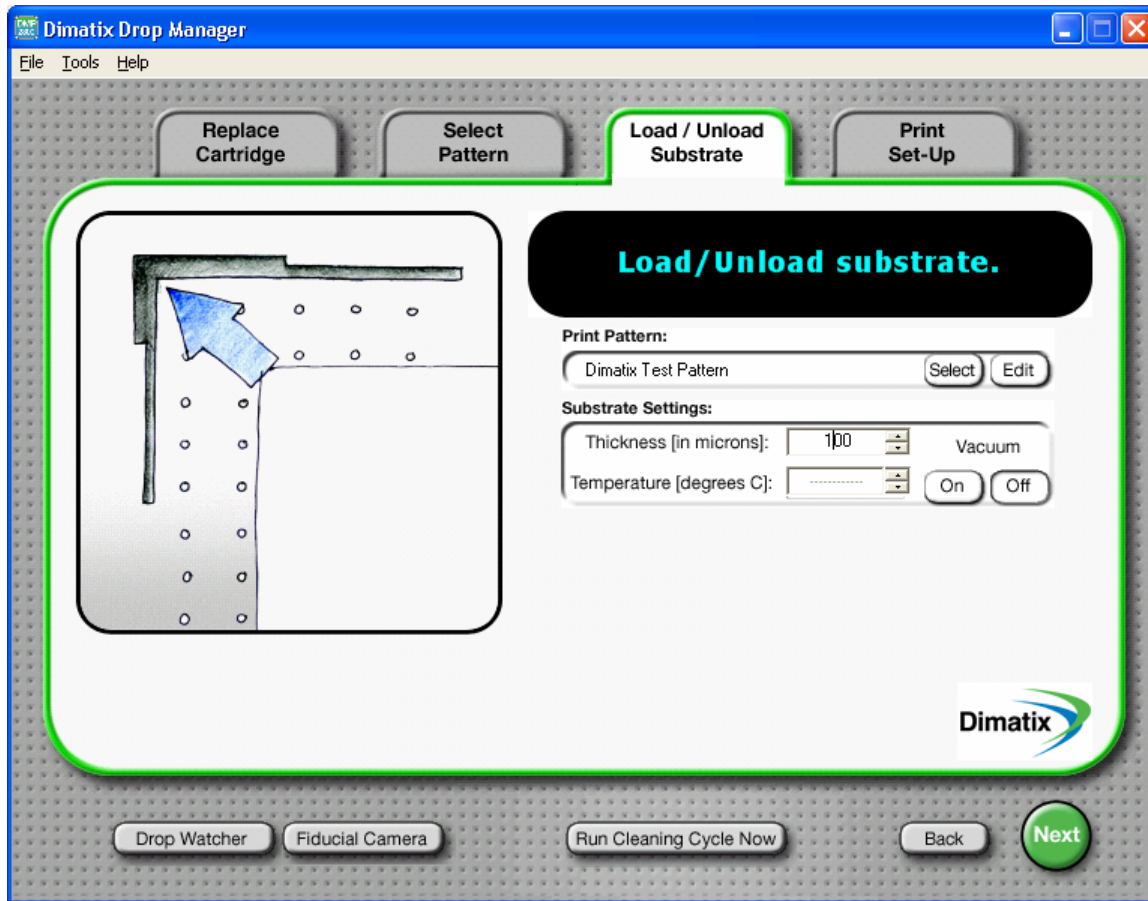icrometers thick. Enter **250** (µm) in the box either by using the up or down arrows on the box or placing the cursor in the box and typing in the number. The system automatically adjusts the height of the cartridge to about 1.0 mm above the substrate. ***Be sure that you enter the correct thickness.*** Entering a number that is smaller than the actual thickness may cause the carriage to crash into or drag across the substrate.

- Open the lid and place the substrate on the platen. Register it to the marks in the back left corner of the platen which is a general substrate registration position. This is important to note since it will be the approximate location from which the patterns to be jetted will be referenced initially.

- After placing the substrate on the platen, turn on the platen vacuum by selecting the **Vacuum On** button. If your substrate is not very flat, stiff, or smaller than the platen you may need to cover some of the open vacuum holes with some mylar, adhesive tape, or other material to direct more vacuum to your substrate.

- If you want to heat the platen, you can enter the temperature in the box by typing or using the arrows. The system will not print until the platen reaches the desired temperature. This may take up to 20 minutes for a setting of 60°C. By clicking on the down arrow on the box you will get to a *line* in the box which represents a setting of "no- temperature." The platen will then run at ambient temperature.

- You are now ready to go to the next step **Print Set-Up** by clicking the **Next** button.

Print Set-Up
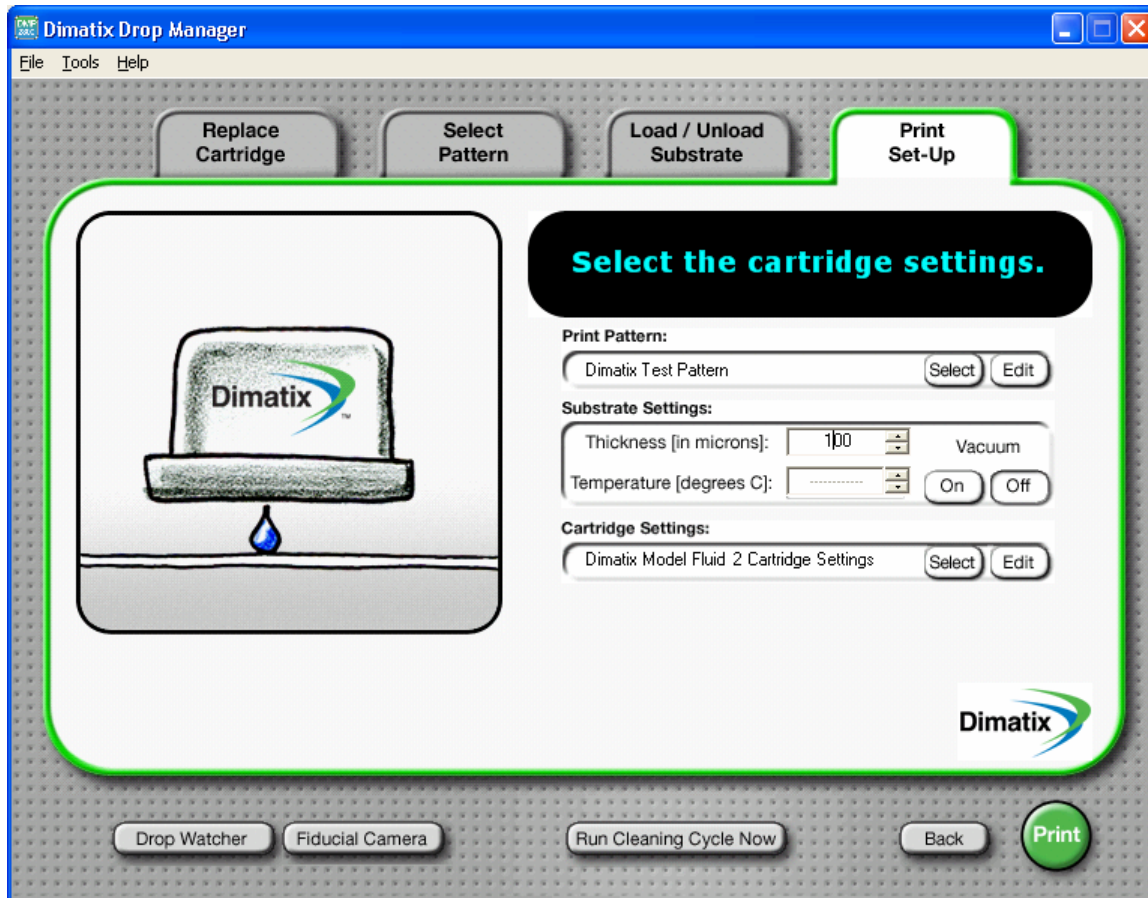
- Now you are finally ready to start jetting. The Pattern has been selected, the Substrate Settings have been entered, and the Cartridge Settings have been entered.

- Click on the **Print** button and the **Print Preview** window will open. This window shows where the print origin is on the platen, where the image to be printed is and the number of nozzles used to print.
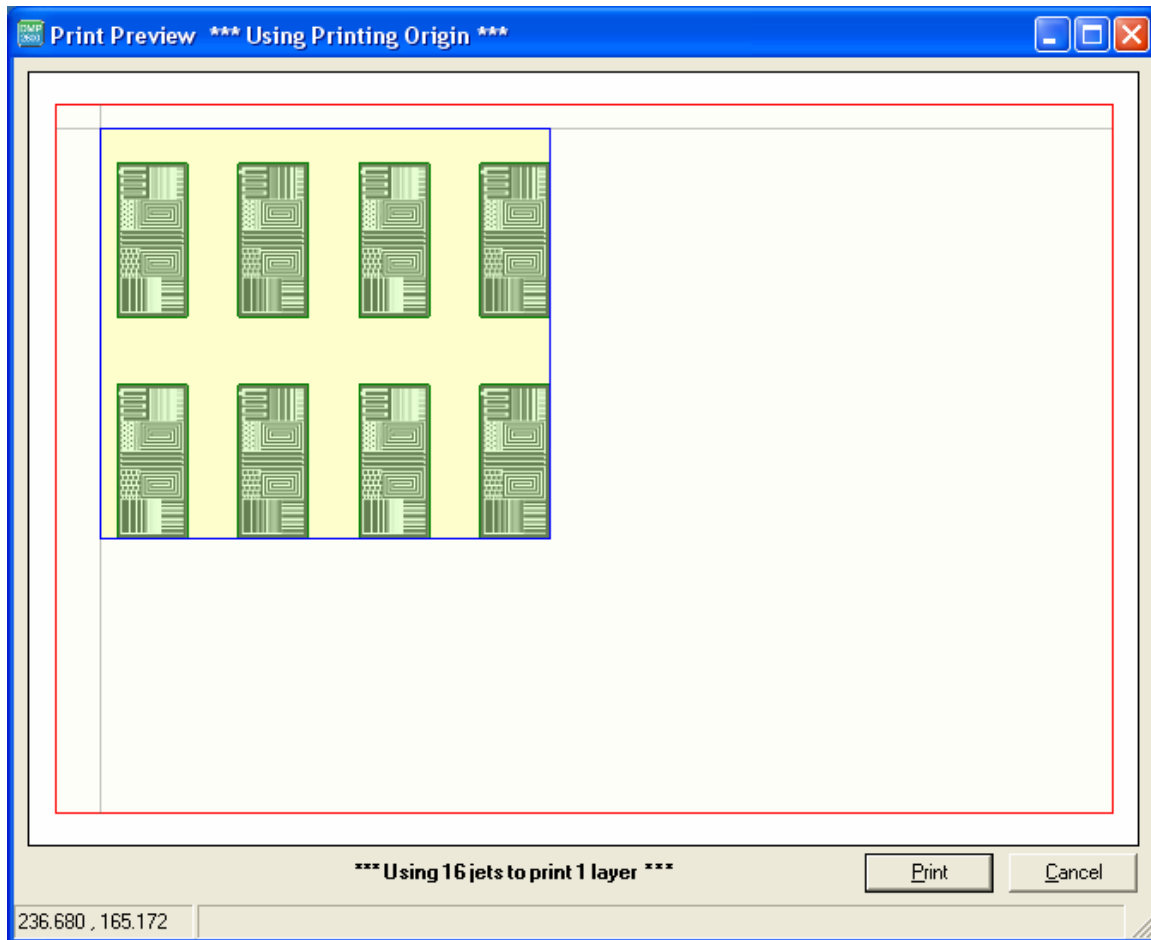
- Click on the **Print** button and the pattern will be printed. Your DMP will jet the test pattern.

Advanced Uses

Now that you have successfully been through a sequence to make a print, you can learn more details that you may need to jet your fluid.

Cartridge Settings

In the start up procedure we showed how to select a file with a specific Cartridge Setting that had been predetermined for the test fluid by FUJIFILM Dimatix. Now we will get into the details of the settings and the editor screens.

You can view Advanced Cartridge settings using the **Tools** menu **Enable Advanced Features**. Additional parameters are added to the cartridge settings:

By clicking on the **Edit** button on the **Cartridge Settings** box, the following screen comes up.
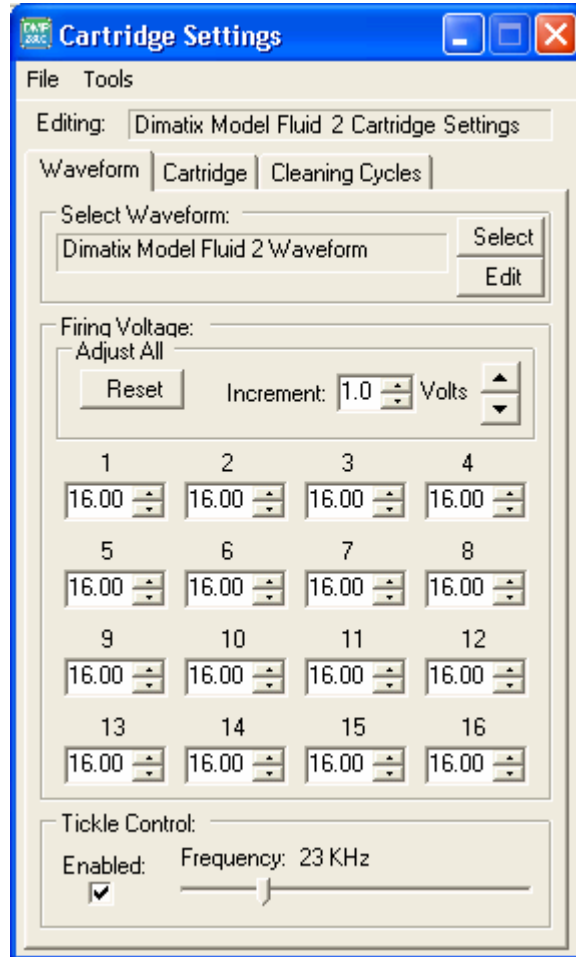
On the above window you can select a previously created waveform in the **File** list. You can adjust the voltage to each jet nozzle individually by typing a number in the individual nozzle box or by clicking on the up or down arrow in the nozzle box. You may want to do this to adjust drop velocities of individual nozzles, since velocity is a function of voltage. You can also change all of them simultaneously with the **Adjust All** arrows. *(See Wavefrom Editor for effects of voltage on jetting).* The **Increment** number is the amount the voltage will change with one click on the up or down arrow buttons.

Note: Once you have established the settings for a particular fluid, you may have to adjust the voltages for a new cartridge to match the drop velocity of a previous cartridge. See **Drop Watcher** for instructions on setting drop velocity.

Note: Tickle control can only be accessed by opening the cartridge settings of the print setup screen in the DMP main program. Opening the cartridge setting via the **Drop Watcher** will not allow you to change tickle control as it will be displayed in gray.

If you click on the **next** tab on the window **Cartridge**, the following screen comes up.
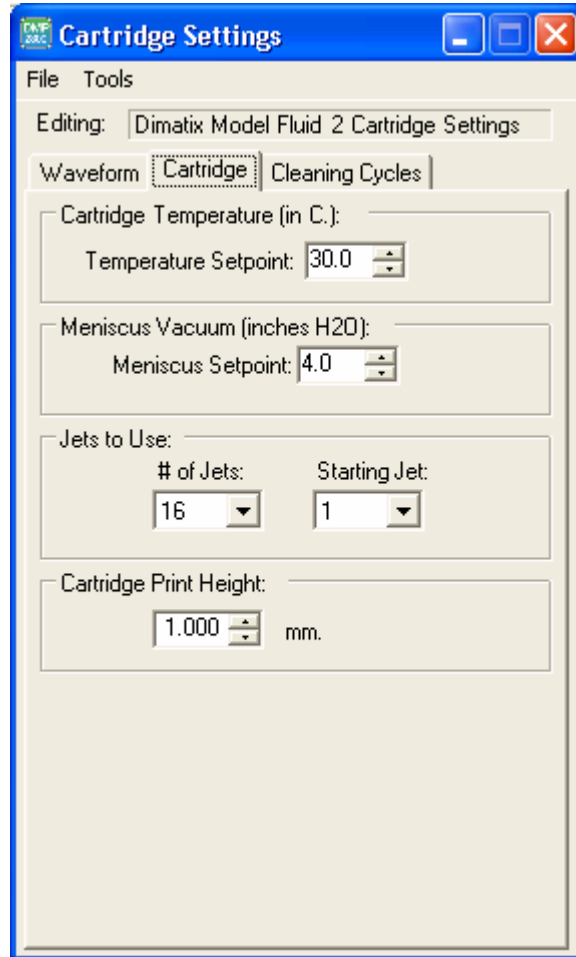
This screen allows you to set the temperature of the cartridge. This is usually used when the fluid is too viscous to jet and you need to lower the viscosity by raising the temperature to get the desired jetting performance.

Also on this window is the setting for **Meniscus Vacuum**. Ink jetting devices operate under negative pressure to keep the meniscus at the edge of the nozzle. You may need to adjust this depending on the viscosity and surface tension of your fluid. Four inches of water is a typical value. Having the correct Meniscus Vacuum level usually affects the high frequency performance of the fluid you are jetting.
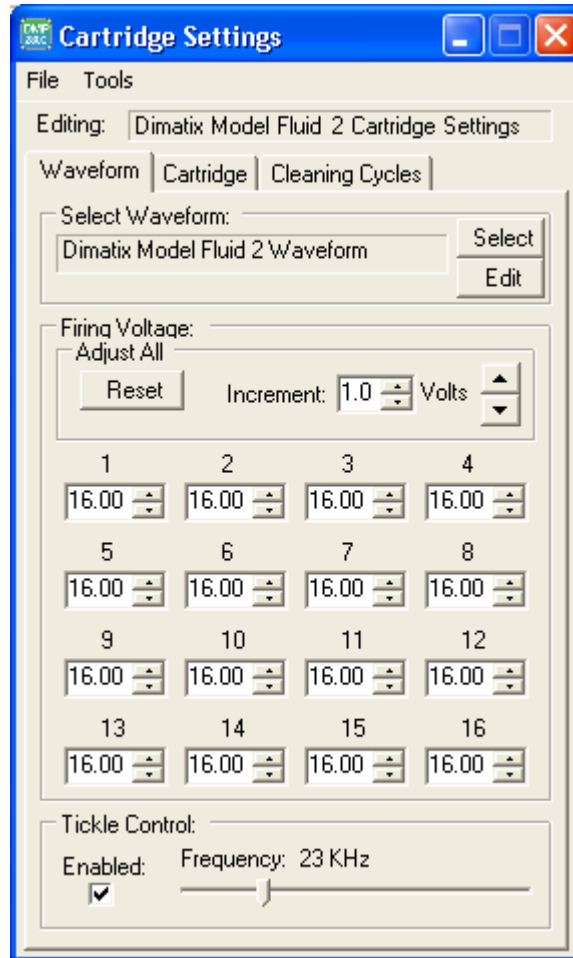
The **Tickle Control** enables and controls low amplitude pulse that is given to the nozzle periodically simply to move the meniscus slightly but not fire a drop. This is to help keep the nozzle from "skinning over" with a thin layer of material left from fluid evaporating. The "tickle" function is completely adjustable, and is very important for some fluids and not required for others.

The low amplitude pulse that tickle control sends to the nozzle can be modified in the waver form editor window as the non-jetting waveform. The frequency set in tickle control is always active when the printer is not printing. This includes the times during which the carriage is above the maintenance pad, on its way to the selected print area or on its way back from one print pass to start the next pass. However, during printing, the tickle frequency is the same as the firing frequency set in the wave form editor. So during one print job, the printer repeatedly switches between the two pulses.
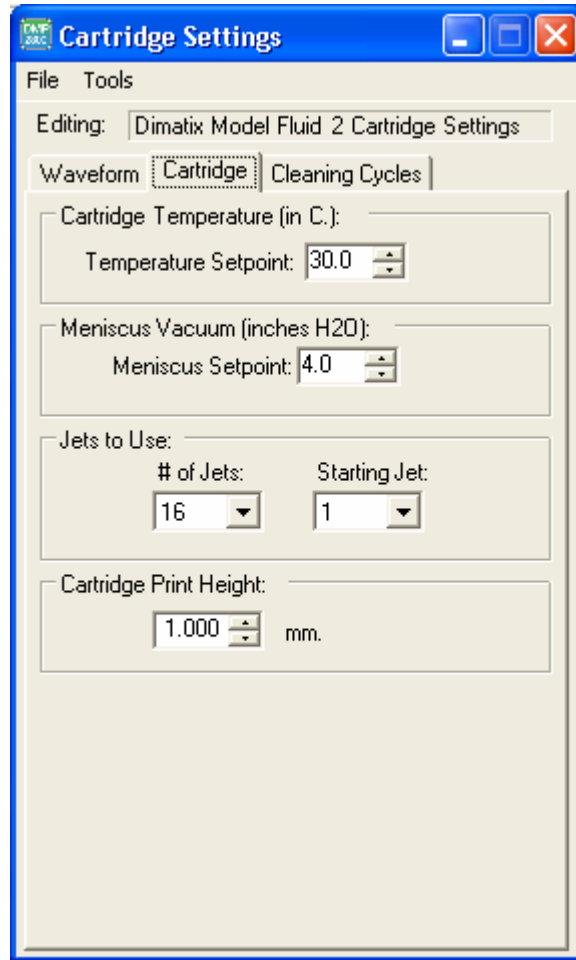
The Cartridge tab's **Jets to Use** function allows you to select only the range of nozzles you wish to use to jet your pattern, if you want to use fewer than all sixteen. The software will automatically compensate for the # of nozzles used but the nozzles selected can only be one series of adjacent nozzles.

The **Cartridge Print Height** sets the distance of the printhead above the substrate during printing. It can be adjusted from .25 mm to 1.5 mm. Take care to set the substrate thickness and Cartridge Print Height accurately to avoid hitting the substrate during printing.
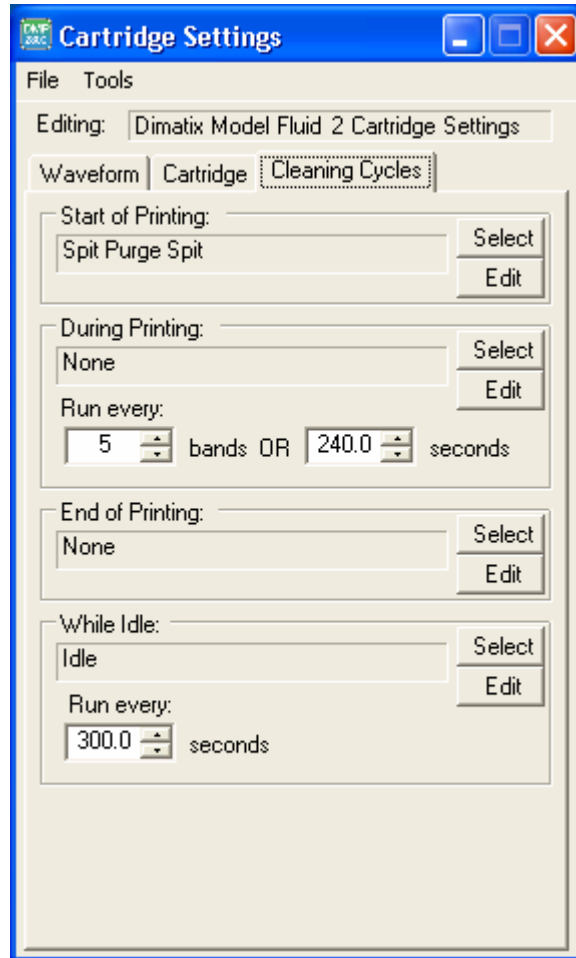
The **Cleaning Cycles** tab let you control how the print cartridge is cleaned before, during, and after printing. Some fluids do not need periodic maintenance, while others need a high amount of maintenance to keep nozzles clear and functioning properly.

- The **Select** button lets you select an existing cycle in the cleaning cycle folder.

- The **Edit** button lets you edit that cycle with the editor window.

- **Start of Printing** refers to the cleaning you want to do at the beginning of the print. Select a cycle you wish to run to enter one in that box or you can edit an existing file with the edit button.

- **During Printing** refers to the cleaning cycle you want to run while printing your pattern. This can be set to run every so many number of **bands** (*one cycle of the carriage across the platen and back is a band*) or every so many **seconds** of printing time. Select a cycle you wish to run by clicking on **Select** and choose one from the folder or you can edit an existing one with the **Edit** button. Whichever is

more frequent between **Run every** x **bands Or Seconds** (depending on printing speed) is the cycle that will be used **During Printing.**

- **End of Printing** refers to the cleaning you would like to do at the end of your printing. Select a cycle you wish to run to enter one in that box or you can edit with the edit button.

- **While Idle** refers to any cleaning you would like to do while the system is not printing but is on and you have a cartridge installed. Select a cycle you wish to run to enter one in that box or you can edit with the edit button.

- **None** can be entered into any box that would have a file name to indicate not to do any cleaning during that time.

- **0** can be entered where numbers are required to indicate not to run that cycle.

Cleaning Cycle Editor

The **Cleaning Cycle Editor** can be run by clicking the **Edit** button by any of the cleaning cycles or by selecting **Cleaning Cycle Editor** from the **Tools** menu. From this editor you can create sequences of operations that can be saved as a cleaning cycle file. Refer to the Cartridge maintenance section in the back of the manual for more details. The default cleaning cycle, **Spit Purge Spit**, is shown below:
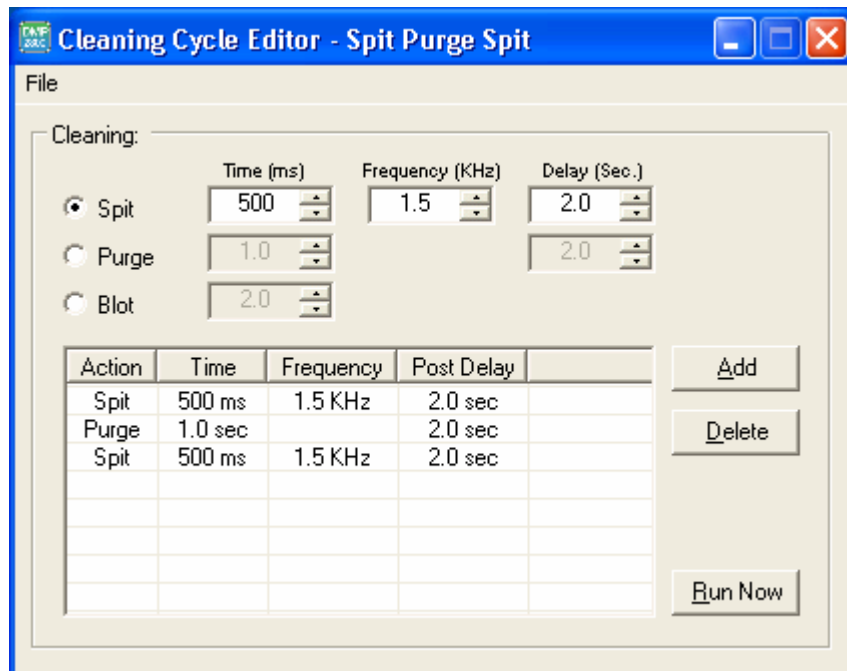
- **Spit** refers to firing the nozzles for the designated time and frequency.

- **Purge** refers to pushing fluid out through the jetting device with pressure (system is preset to 5psi). This process is usually used to get air out of the jetting device.

- **Blot** refers to the cartridge simply coming down and making contact with the cleaning pad for the designated time. *** Note:** It is important to make sure that the cleaning pad is not saturated or clogged to ensure good removal of the fluid from the nozzles after purging or spitting.*

- The **Delay** time is the time after the cleaning before going to the next step in the cycle.

A cleaning cycle can be very simple, such as a "2 second blot" or they can consist of several combinations of actions (spitting, purging, and blotting) with varying times.

Here is how to create a Cleaning Cycle:

- Click on the **Spit**, **Purge**, or **Blot**.

- Then enter a number or use the arrows for the **Time**, **Frequency** or **Post Delay** that you want.

- Click the **Add** button and that will enter it into the table and incorporate it into the cycle.

- If you want another action to occur next, simply repeat the process.

- If you want to delete a step, highlight it in the table by clicking on it, then click the **Delete** button.

- When you have built your cleaning cycle, save it (by going to File-Save As) with a name that describes what it does. That way you can easily identify it in the folder in the future.

If desired you can run the Cleaning Cycle you just created by clicking on the **Run Now** button.

Also under the **Tools** option in the **Cartridge Settings** window you will find the **Waveform Editor**. Click on the **Waveform Editor**.

Waveform Editor
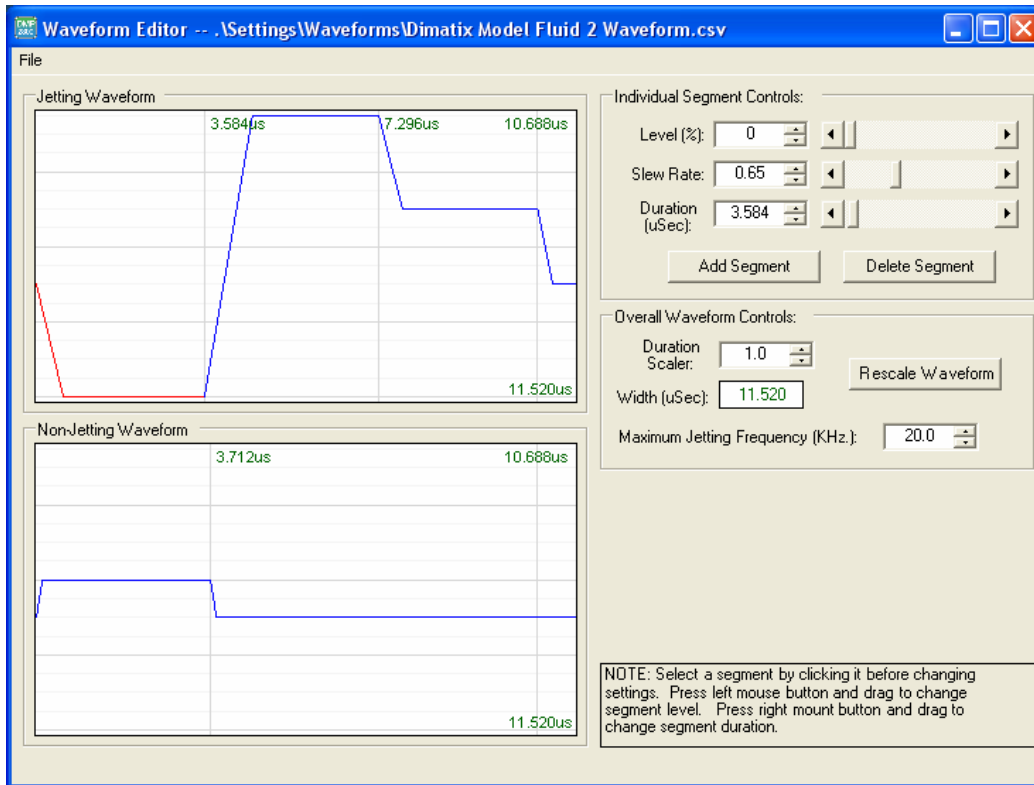
This is the most powerful screen in the control software regarding jetting fluids. On this screen you control the shape of the pulse to the nozzle to eject a drop. To adjust a segment, simply point your arrow to it and click on it. The selected segment will change from blue to red.

Individual Segment Controls:

In this box you have several parameters at your control. When you want to modify a segment you click on that segment on the graph with the mouse to highlight it. Then you can modify the parameters for it by typing in a number, using the up/down arrows or slider bar.

> **Level** – This is the percent of the amplitude relative to the value you have in the Cartridge Settings: Waveform screen.
>
> **Slew Rate** – This is the slope of the line in the waveform during voltage ramps.
>
> **Duration** – This is the length (time) of the segment.

You can add a waveform segment to optimize drop ejection by clicking on the segment that you want to place a new segment in front of and click the **Add** button. You can now

modify that segment as you would the others. You can delete a segment simply by clicking on it and selecting the **Delete** button.

Overall Waveform Controls

Duration Scaler – This feature allows the user to easily scale the entire waveform pulse width at once. This is useful when you are using fluids with different densities. Higher densities generally need longer pulses. Enter a number in the box then click the **Rescale Waveform** button. The entire waveform's width will change by multiplying its current width by the Rescale number. For example, if you enter 1.1 in the **Duration Scalar** box, it will adjust each waveform segment's length proportionally to multiply the waveform's overall width by 1.1, which is a 10% increase.

Width – This box displays the overall pulse time width for the entire waveform.

Maximum Jetting Frequency – This is a number the user can enter to prevent the DMP from jetting the fluid at a frequency higher than that which may have been determined as the upper stability limit through drop watching. It also sets the scale for the *Firing Frequency Maximum in the Drop Watcher*.

Note: The DMP will always try to print with a carriage speed of 300mm/sec unless it is Maximum Jetting Frequency limited.

Non-Jetting Waveform

The **Non-Jetting Waveform** can be modified by clicking on an individual segment and moving it. The instructions are in the box to the right of the graph.

**Jetting Waveform vs. Non-Jetting Waveform**

When the printhead travels over the print area, the software automatically tells it which nozzles to fire and which are idle. The idle nozzles still get a small amplitude signal transmitted to them. This is the **Non-Jetting Waveform**. The firing nozzles get addressed with the **Jetting Wave Form**.

The **Non-Jetting Wave Form** is also the pulse signal that the **Tickle Control** sends to the printhead during non-printing times when the carriage is above the maintenance pad, or when it is moving to the defined print area or moving between two print passes. This keeps the fluid in the nozzle in motion and helps prevent it from drying out.
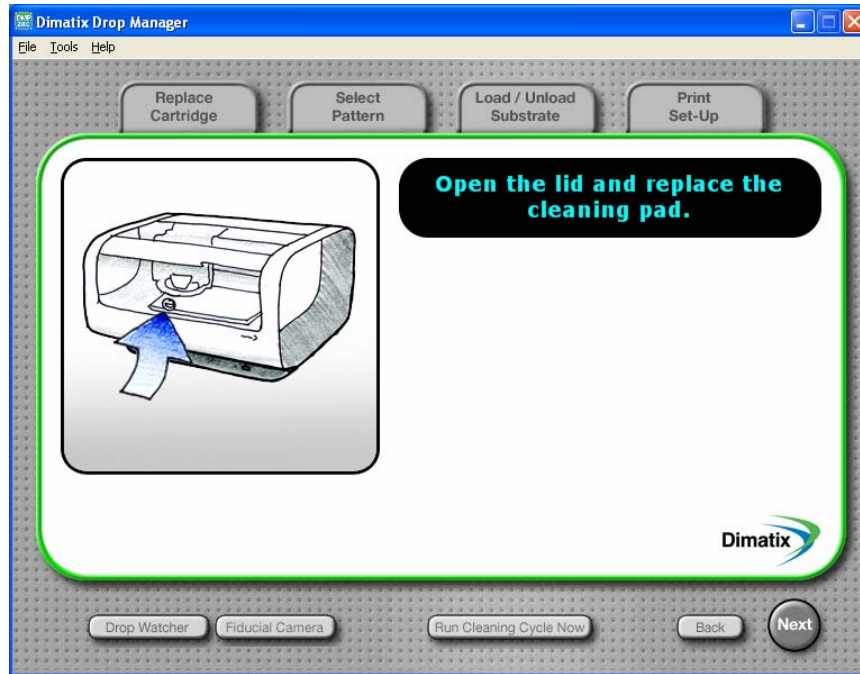
Replacing Cleaning Pad

Located in the **Tools** pull down menu on the main screen is a feature called **Replace Cleaning Pad**. You will want to replace the cleaning pad with a new one when it gets filled with fluid or clogged by fluid residue and does not effectively blot the nozzle surface of the cartridge, or you are changing cartridge fluids and don't want cross contamination from contacting the previous material on the cleaning pad.

To replace the cleaning pad select **Replace Cleaning Pad** from the **Tools** menu. The cartridge will move to allow access to the pad.
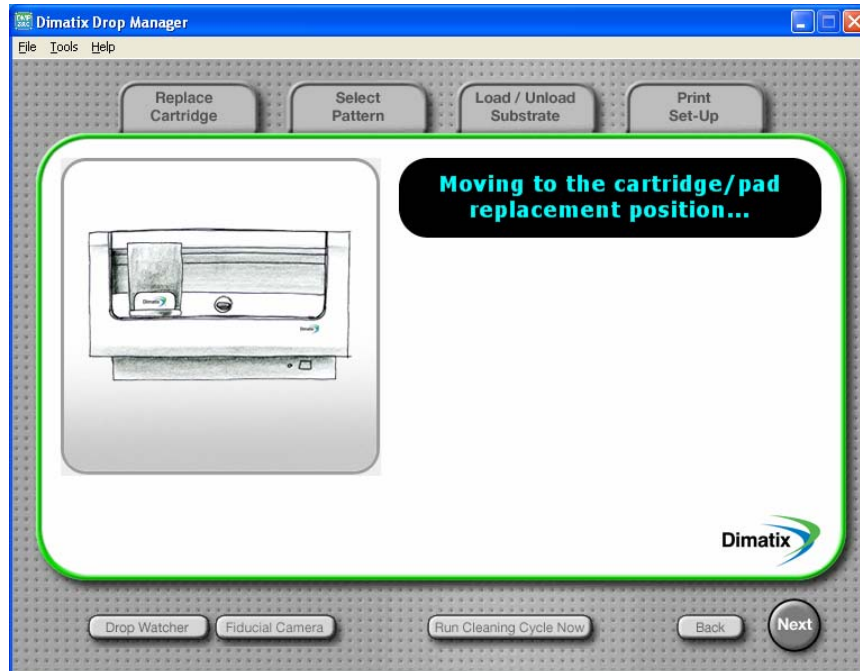
DO NOT open the printer lid until told to do so. Opening the lid while the printer is in motion will necessitate a re-initialization of the printer motors.

Open the lid and replace the pad.
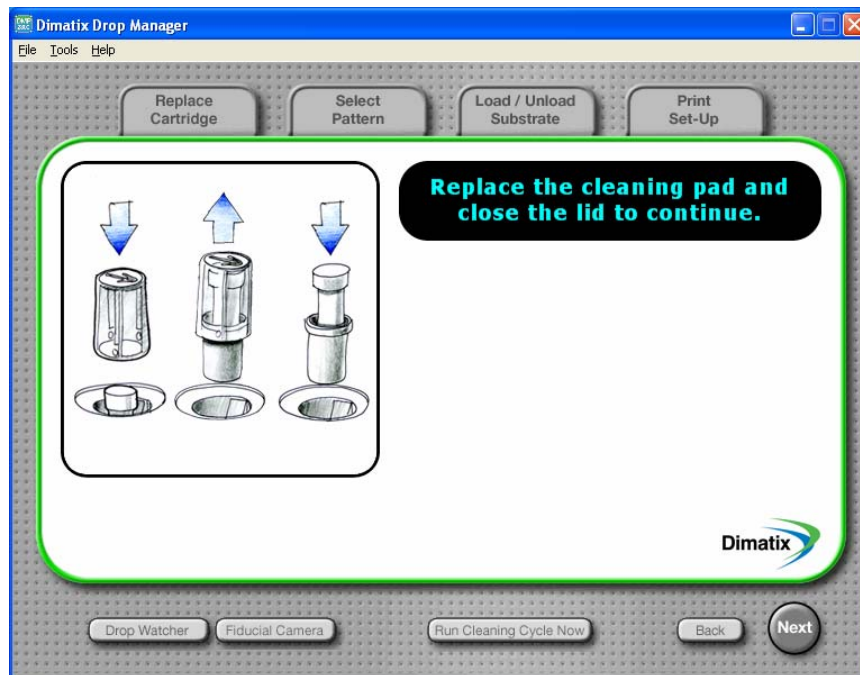
Replace the pad by:

- Taking the top clear cap of a new Cleaning Pad assembly and push it down on the old pad until you hear a click and then simply pull it out.

- Insert the new pad and holder by pushing the pad and holder down into the spot where the old one was until you hear a click.
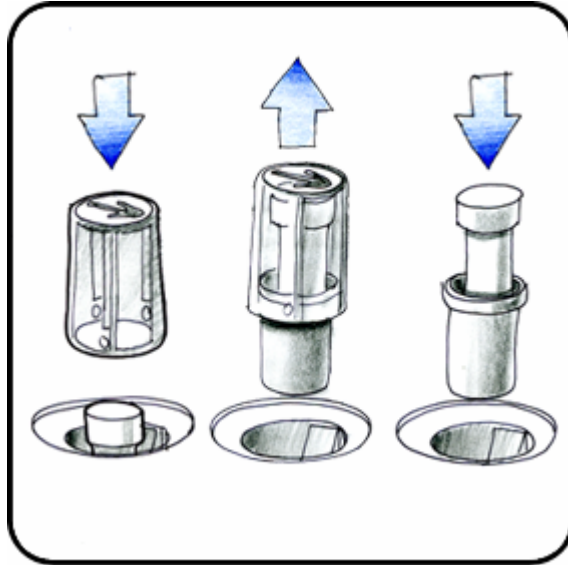
Be careful not to remove the cleaning pad by itself. This may damage the springs holding the receptacle which will then not position it correctly.

When the lid is closed the carriage will move back to the cleaning station.

Pattern Printing

Note: If you are printing a pattern on a substrate that you will either remove and reposition, or change cartridges, be sure to set the Printing Origin before printing the first pattern.

Select Pattern

The following screen allows you to pick a print pattern file that has already been created, or to create a new one.
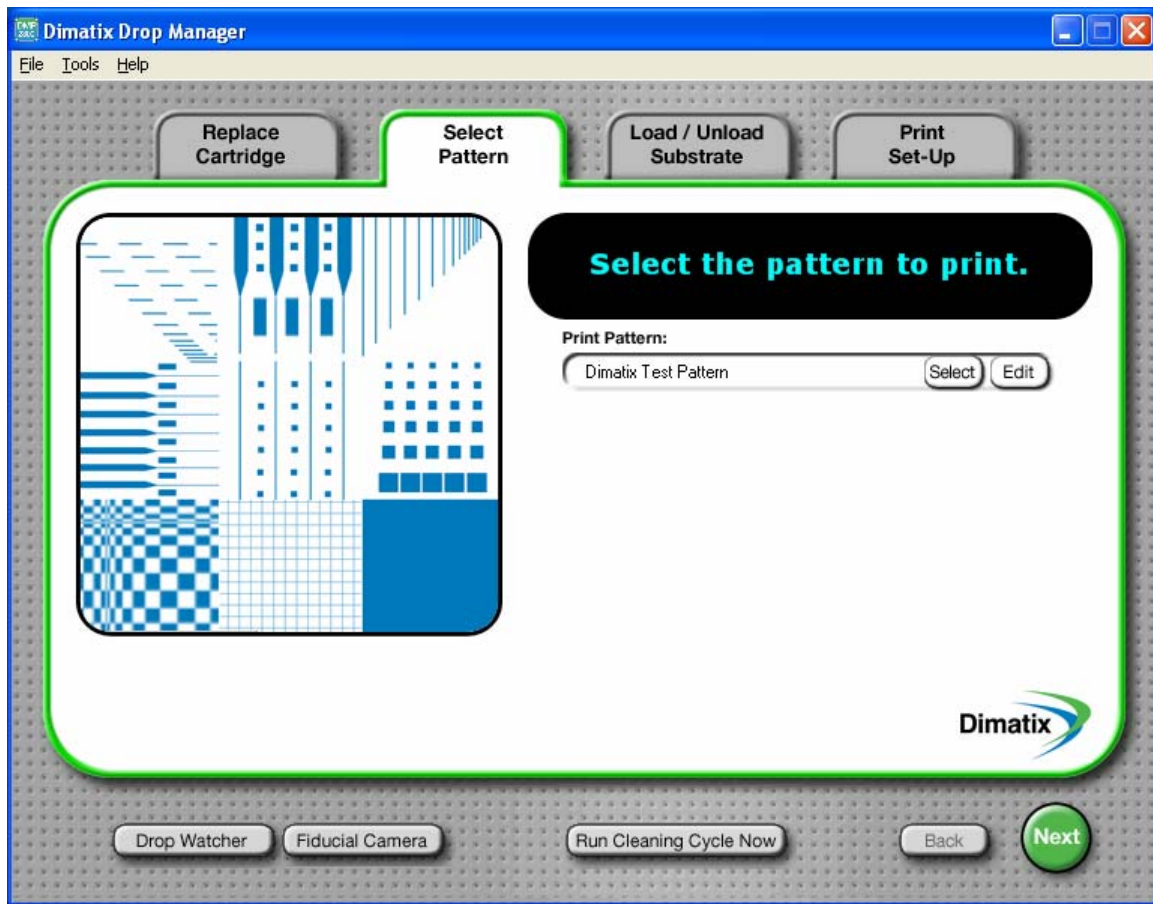
From the **Select** button in the **Print Pattern** box you saw earlier that there are several pre-defined standard pattern files.

Pre-Defined Standard Patterns

| Microscope Slide 25K array | Line Array | 1 mm Hatch | 1 cm Solid | Dimatix Test Pattern |
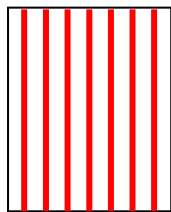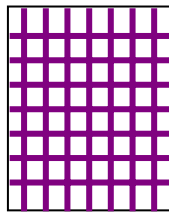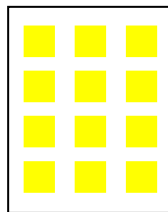
Create Your Own Pattern

The **Pattern Editor** allows you to create or modify pattern of drops for printing, and easily repeat it if desired onto a substrate. The basic pattern of drops at the lowest level (the **Pattern Block Array** table) is user-defined as a collection of rectangles. Each rectangle in the t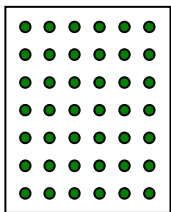able may be small enough to represent a single drop, or thin enough to represent a line of drop, or large enough to represent a filled-in rectangular area.

In all cases, X increases to the right, and Y increases toward the front of the printer. All dimension parameters are in millimeters except for the **Drop Spacing**, which is in microns. **All** dimensions entered into the pattern generator are rounded onto the **Drop Spacing** which is the spacing between drops to form a pattern feature.

By selecting the **Edit** button on the **Select Pattern** screen the following screen appears:
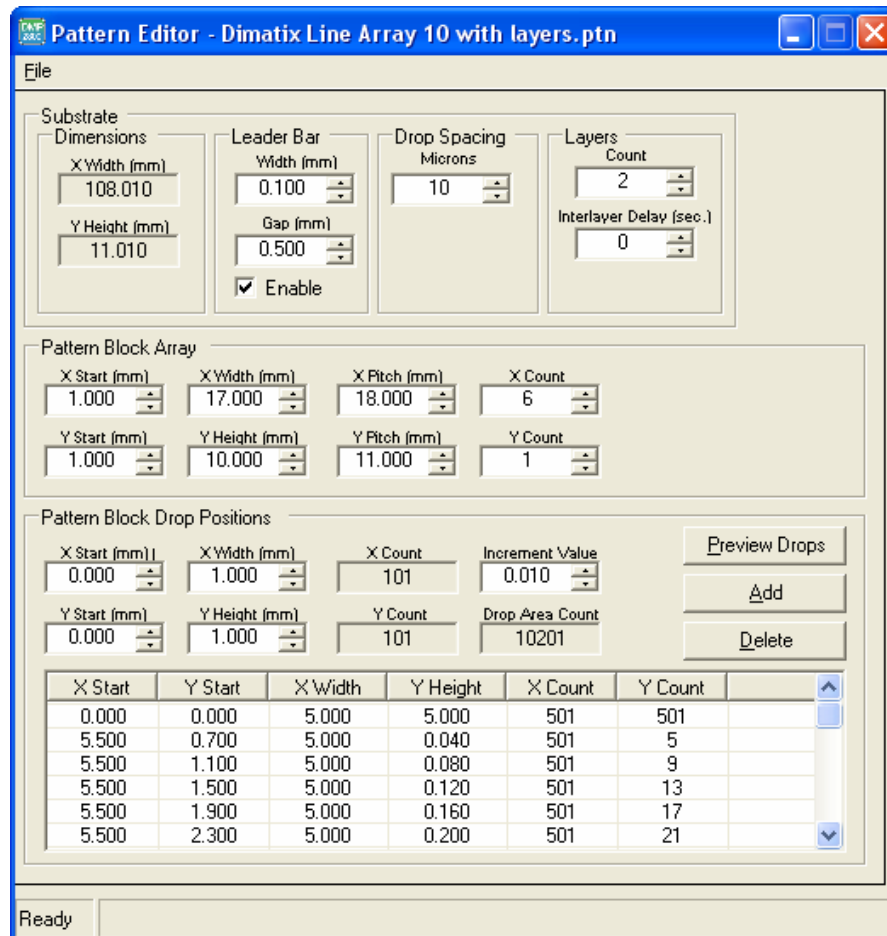
Substrate

The **Dimensions** is the *total area* that will be printed. Generally most people will jet on only a single substrate. But you could place several smaller substrates on the platen and jet on all of them at once. Verify that the total area is not larger than your substrate.

The **Leader Bar** is a vertical bar that can be jetted (by checking the **Enable** box) which will precede your pattern. This is often used to "pre-fire" nozzles to keep them active and their drop velocity uniform to improve pattern quality. The **Width** of it and the **Gap** of the Leader Bar can be entered in the boxes.

The **Drop Spacing** is the center to center distance from one drop to the next in X and Y position to create the pattern. This can be adjusted in 1 micron increments with a minimum of 5 microns. Usually a drop spacing around 20 microns gives good printing results. The X spacing is controlled by the x axis encoder, while the y axis is controlled by the cartridge angle.

The **Layers** box feature allows you to reprint the same pattern over itself automatically. The **Count** number is the number of times you want to print the pattern and the **Interlayer Delay** is the delay time between each layer, additional to the amount of time spent doing any Before Print or After Print maintenance on the cartridge.

If you click on the **Preview Drops** button a window will pop up showing the area you have designated. The total area of the window represents the platen. If the substrate area you entered is smaller than the platen it will show as a beige shape inside the white area.

Your **Pattern Block Array** area is delineated within the substrate area outlined.
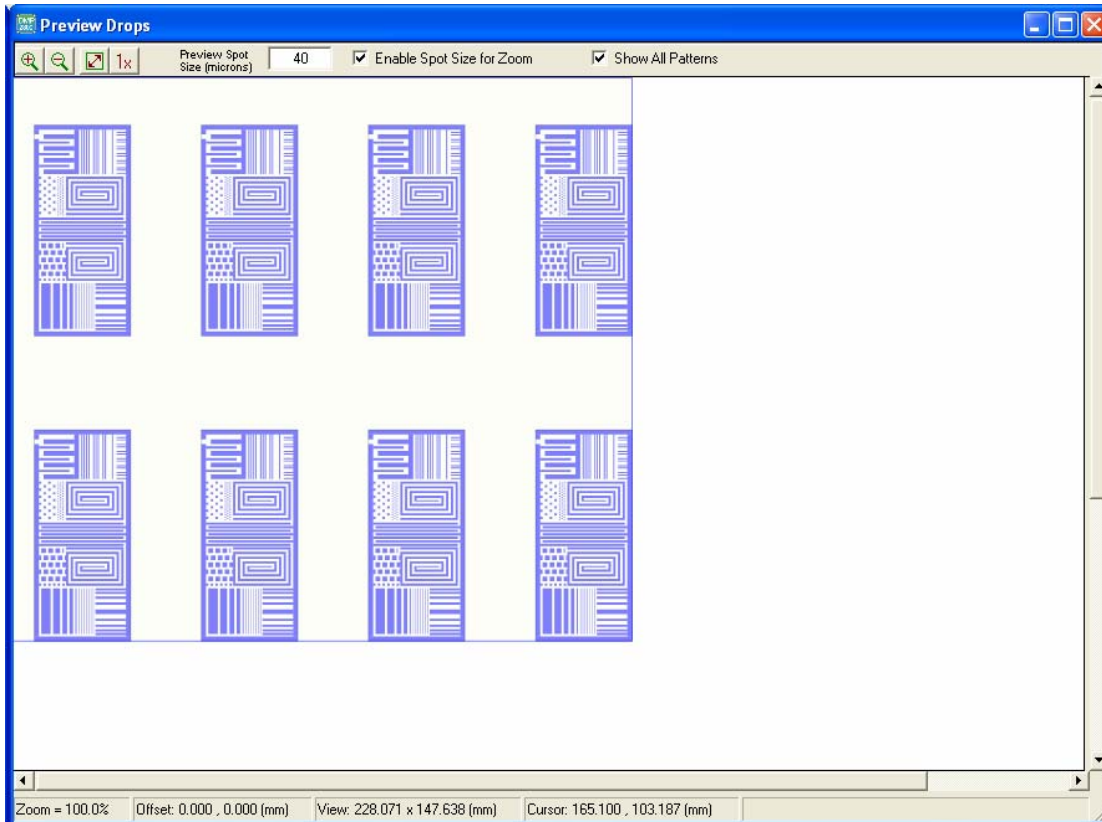
Pattern Block Array

In the **Pattern Block Array** box enter the point on your substrate where you want the pattern to start printing in X and Y, referencing from the print origin. Then enter the X width and Y height of the block you want to make. The X and Y sizes entered should be at least large enough to enclose the collection of rectangles defined in the **Pattern Block Drop Positions** (see below).

Note: The default print origin is approximately -1 mm, 7 mm (x,y) from the 0,0 corner scribed in the back left of the platen.

To print a repetitive array of the pattern block in your print area, enter the X and Y **Pitch** dimensions. The **Pitch** is the distance from the start of one pattern to the next. Enter the number of repetitions (**X count**) to print in the *horizontal* direction, and the number of repetitions (**Y count**) to print in the *vertical* direction.

Pattern Block Drop Position

The pattern generator works with one or more user-entered rectangles of X width by Y height. When you enter the dimensions of your feature in the appropriate boxes and click the **Add** button, it will be placed in the table on the bottom of the window.

Note: Only those rectangles that are added to the table on the bottom of the pattern editor window get saved once you are done creating your pattern.

In the **Pattern Block Drop Position** box:

- Enter the position (X and Y) where you want to place the first drop in your Pattern in the Pattern Block.

- Then enter the **Length** and **Height** of the "feature" you want to create. For lines, enter the width height of the line that you want. For example, for a horizontal line you would enter how long you want it to be in the x direction (X, width), maybe 10 mm, and for 200 microns "tall" you would enter 200 microns for the Y Height. For the same vertical line, it would be 200 micron X width, and 10mm Y height. To define a feature that is a single row of dots or a single dot, use a dimension or dimensions smaller than the Drop Spacing parameter

- The **Increment Value** is the value at which you want the dimensions to change with each click of the arrow buttons. For example and Increment value of 1.000 will change the dimension 1 mm for every click of the arrow. The Increment vale gives you a convenient way to generate a set of related rectangles.
  * You can also very easily create a rectangle by placing the cursor on **the Preview Drops** window, place the cursor in a **Block**, hold the **Shift** key down and "point, click and drag" to create a rectangle.

If you click on the **Preview Drops** button, a window will pop up which shows you the pattern. When you click on a line of data in the table specifying a feature, that feature will show up in red on the **Preview Drops** screen. You can **Zoom In** on the feature by clicking on the "+ *magnifying glass button"* to where you can see the individual spots. When you **Zoom In** it is best to have **Show All Patterns** *de-selected* to reduce data crunching. You can continue Zooming in until you see the grid background. Then when you hold the **Ctrl** button on the keyboard and point and drag the left mouse button on

your feature of interest you can zoom in and it will stay centered on the screen. You can also zoom in by hold down the *Ctrl* key on the key board, placing the cursor on your point of interest and clicking. This will zoom you to the individual drop and grid level.
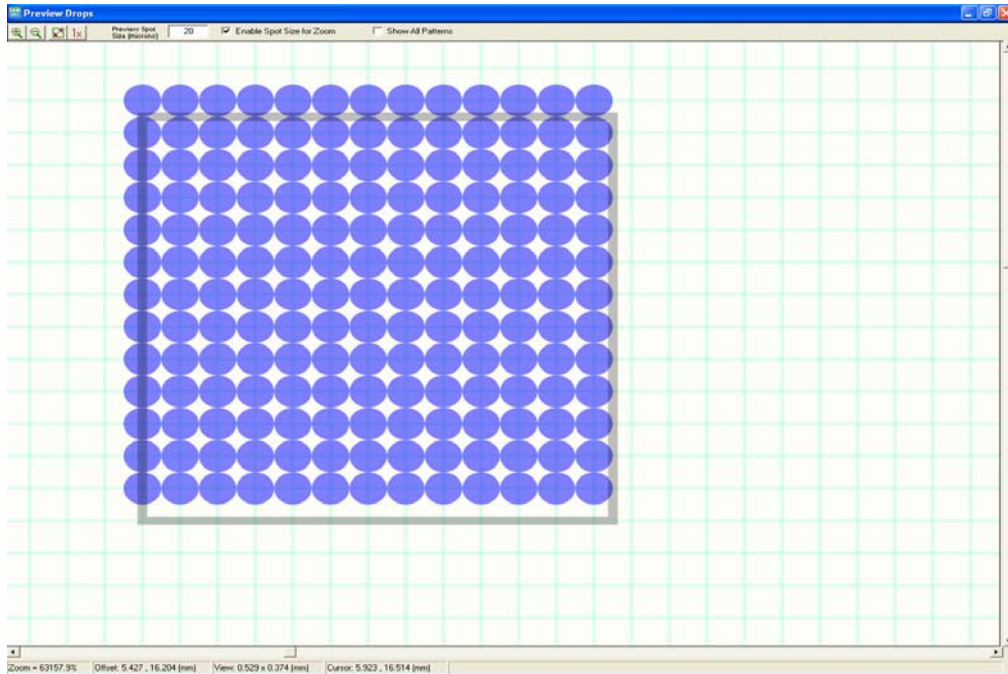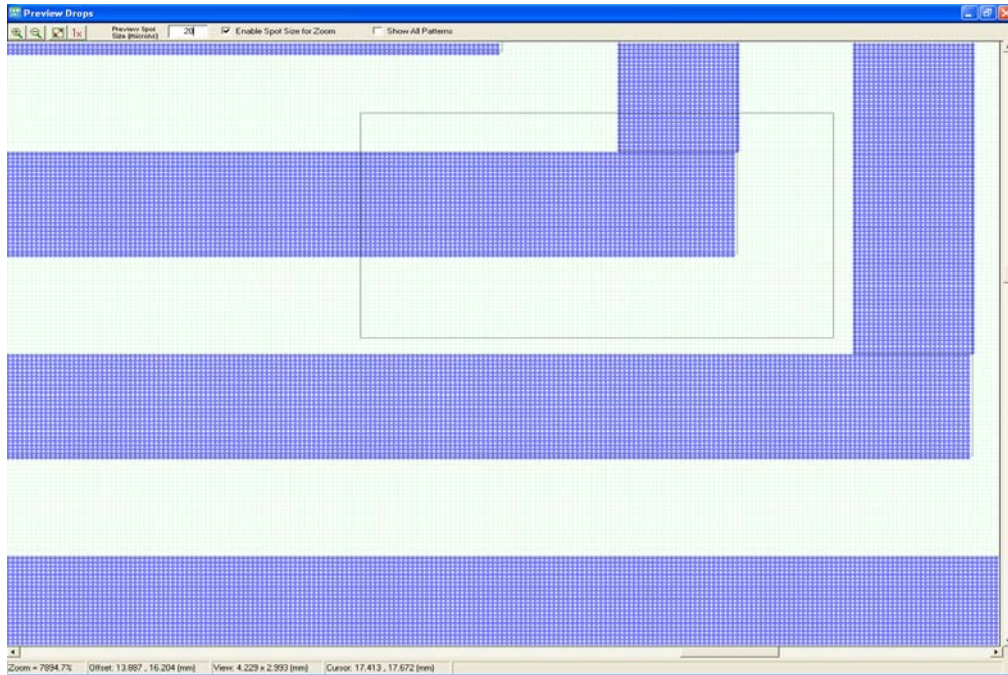
You will see grey lines on the screen which represent the pattern as you created it in the Pattern Generator. The dots are actually where the drops will be placed as the dimensions are round to fit on the grid you have defined in the **Drop Spacing**.

If you highlight a line in the table and click the **Add** button you will duplicate that feature. It will be jetted right on top of itself unless you change the x and y start points, which you can do by highlighting that data line in the Pattern Generator table and then changing the numbers in the appropriate boxes.

The **Preview Spot Size** box let's you enter the diameter of the spot that a single drop makes on your substrate. This is helpful to visualize how much separation or overlap of drops you have in the pattern features depending on their size and the Drop Spacing used. When reviewing the pattern to see how the features match the grid or how adjoining features line up set the **Spot Size** to 10 microns.

The **Enable Spot Size** feature allows you to zoom in on the image and view the individual spots of your pattern. Putting a check in the box by clicking on it enables it. Click on it to disable it to view all of the patterns.

The **Show All Patterns** feature enables you to see all the patterns on the substrate when checked.

The **1x** button feature displays you pattern on the screen to very close to its actual size.

Drop Spacing

The Drop Spacing is the distance in X and Y, center to center, of the drops that the DMP will deposit to create the pattern. Drop Spacing is adjustable between 5 and 254 microns in one micron increments. It will toggle with the arrows on the box in five micron increments. For example, with a 50 micron Drop Spacing, the pattern generator will place drops 50 microns apart in X and 50 microns apart in Y to fill in your pattern. So, for a 100 micron wide, 10 mm tall vertical line, the system will place 3 drops in the X direction (one for the first edge, another at 50 microns, and another at 100 microns for the next edge) by 2,001 drops tall. The Drop Spacing therefore determines your resolution or density in the X direction and determines the angle at which the cartridge must be set to get the same resolution or density in the Y direction. The Drop Spacing parameter is most useful for altering the fill density (amount of jetted ink per unit area) of lines and rectangles, or it

may be used to create rows of individual drops which are spaced closer together than 254 microns. When you create a pattern the dimensions and locations of the features should be divisible by the Drop Spacing for optimum placement matching. If not there may be some shift the features.

Nozzle Test Pattern

There is a 16 line test pattern which can be run to see the performance of each nozzle individually. This is done while on the **Print Set-up** window by holding down the control key on the key board and clicking on the **Print** button on the bottom right of the window. Set the cartridge to 90 degrees before running the pattern.

BMP and Gerber File Printing:

To import BMP files or Gerber files into the DMP Software, select **Tools** on the main screen. Then select **Pattern Editor (Bitmap images)**. This will open the **Image to Pattern Converter** window. Then under **File**, select **Open BMP** or **Open Gerber** to open your file. *The Gerber Tools option must be loaded in the system for Gerber File conversion.*

Gerber Files

To open a Gerber file, set the drop spacing you want the image printed to and then select '**Open Gerber'** from the **File menu**. Select the Gerber file you want.

The Gerber file will be processed into a BMP at the selected drop spacing resolution.
All of the controls will operate as if it was a BMP file with the exception of drop spacing and X Width, Y Height. Since a Gerber file is resolution independent, changing the drop spacing does not change the dimensions of the output.

*If you change the **Drop Spacing** you must then save the file for it to be processed at the new drop spacing.*
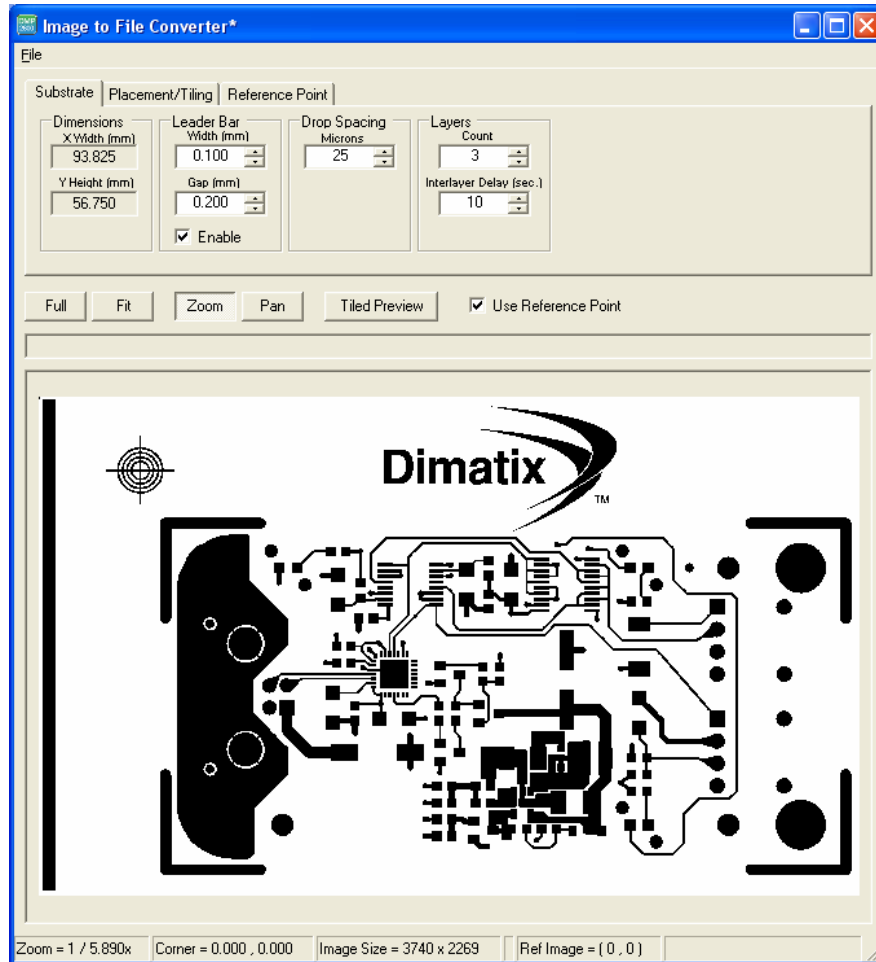
The **Substrate** Tab has the following features:

- o **Substrate Dimensions** – this is the calculated minimum size of a substrate that will be needed to print the pattern
- o **Leader Bar** – This is the same as in the Pattern files. This is a vertical bar that you may add to your pattern to enhance printing quality.
- o **Drop Spacing** – the same as in Pattern Printing, this is the spacing of the drops (center to center) in x and y that will be jetted to create the pattern. The x spacing is encoder controlled and the y spacing is set by the cartridge angle.
- o **Layers** – this is the same as in Pattern Printing and allows you to re-print the same pattern over itself several times (Count) with or without a delay (Interlayer delay).

The **'Full'**, '**Fit'**, **'Zoom'**, and '**Pan**' enable movement and zooming of the image. When an image is first loaded it will zoom to '**Fit**'. This shows the full extents of the bitmap.

Clicking the '**Full**' button will zoom in on the image to the point where each pixel in the BMP file is displayed as a pixel on the screen. The form may be resized to provide a larger preview.

If the **Zoom** button is selected, then clicking and dragging the left mouse button over the image will create a zoom window. When the mouse is released the image will zoom to the selected area. If '**Pan**' is selected, clicking the left button and dragging in the image will move the viewable image in the window. These controls can be used to view the high resolution data and aid in selecting the reference point.

Tiled Preview allows viewing of all the patterns to be printed.

Placement / Tiling
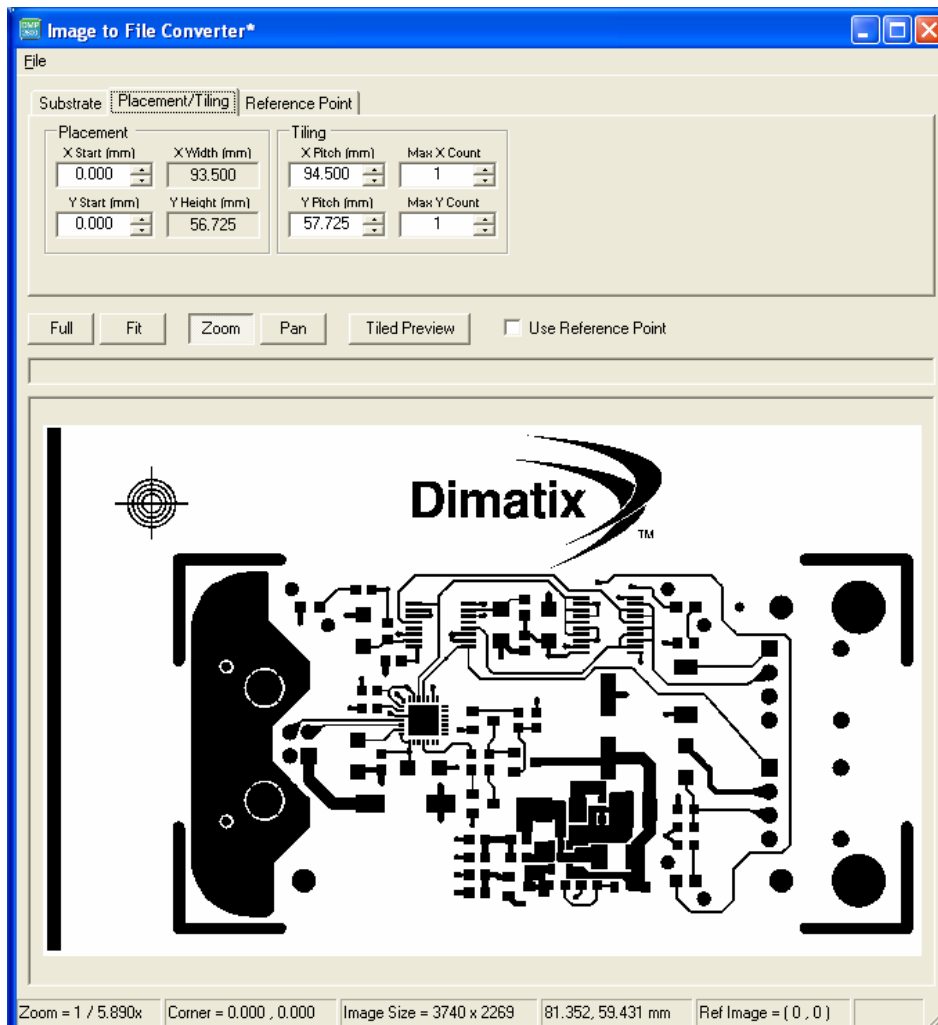
Placement:

 X Start, Y Start is the position relative to the Printing Origin that the pattern will start.

 X Width, and **Y Height** is the calculated size of the pattern.

Tiling:

This is used to make multiple print copies of the same pattern. The **Pitch** is the distance from the beginning of one pattern to the next as set in X pitch and Y pitch. The number of patterns is set by the **Count**.

Reference Point:
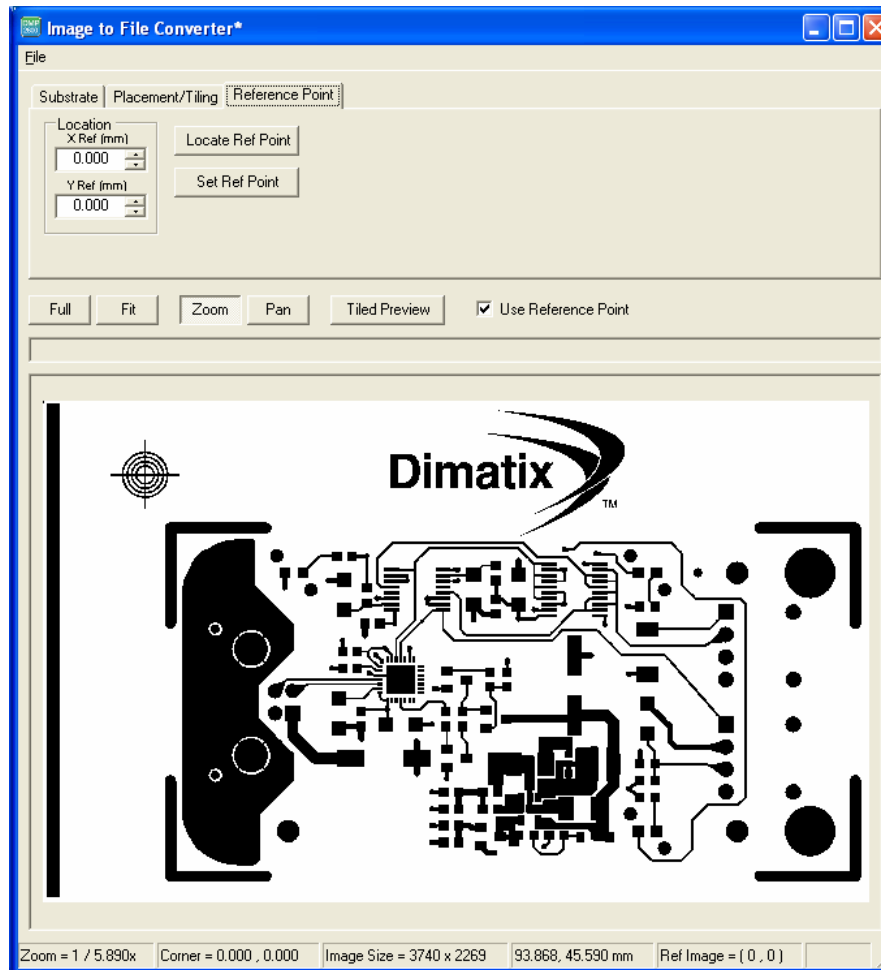
The **X Ref**, **Y Ref**, '**Locate Ref Point'**, and '**Set Ref Point'** provide an additional way to position the image by aligning a point in the image to a specific point on the substrate (a point is selected in the image and a corresponding point is selected in the Fiducial Camera form).

- To print using a Reference Point in your image, check the box "**Use Reference Point**"

- To set a **Reference Point**, first locate the part of the image you wish to align to by either using **Zoom** or **Pan**. Click '**Set Ref Point'**. Then place the cursor on the point in the image. You can make fine adjustments by clicking the arrow up/down buttons next to the **X Ref** and **Y Ref** fields. If you know the dimensions for the **Reference Point** you can type them in directly into the **X Ref**, **Y Ref** boxes then click '**Locate Ref Point'**. This will take you to that specific point in the image. The cross hair cursor that displays the reference point will show when the pattern is printed.

- To complete the **Reference Point** usage, go to the **Fiducial Camera** window (see Fiducial Camera section). Click on the Fiducial Camera button on the main Drop Manager window to open the Fiducial Camera.

- In the **Tools** menu of the Fiducial Camera click on the "Set Reference Point" button. Click OK on the pop up window.

- Find the point on your substrate where you want to place your selected image Reference Point by moving the camera to the desired position. Place and click the cursor on your point.

- Click the "**Use Reference Point**" box on the Fiducial camera window.

- Do not close the Fiducial camera window before you print. It must stay open. Simply click the **Print** button on the main **Drop Manager** "**Print Set-Up**" window.

The X Width and Y Height values are filled in when a file is loaded. The size is based on the image size and the drop spacing. BMP files must be printed at the Drop Spacing (resolution or dpi) they were created for, or the image size will change accordingly.
A status bar at the bottom shows the current Zoom Factor, the location of the upper left of the preview, and the Image Size. The current cursor position is also displayed.
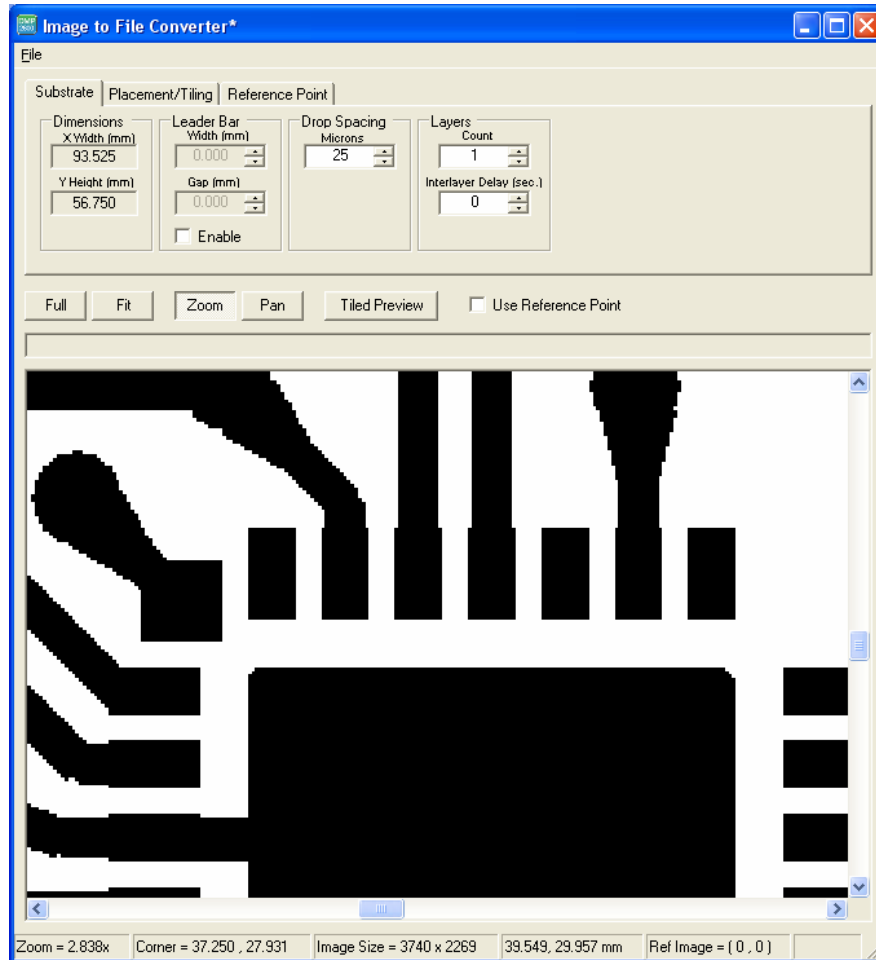
When all of the parameters are correct you must save the file as a pattern file (it has a .ptf extension). The pattern file is what can be selected from the main form or the fiducial form to print.

Print Preview

The Print Preview can be disabled or enabled in the Main Dimatix Drop Manager Form '**File**' menu. If it is on, it will show a preview before the printing starts. The Title Bar of the dialog tells if the reference or printing origin is being used. The **origin (or reference point)** is marked with a cross hair. The Leader Bar is shown if it is enabled.

The preview is sizable so it can be made full screen for more detail. Remember, the platen area is not the substrate! The user has to make sure the substrate is placed correctly on the platen and that it will fit the image they are going to print. The preview is meant to make sure they have set the origin and tiling correctly.

The following are some sample screen shots using the **Reference Point** and **Leader Bar** on a tiled pattern. The **Reference Image** used in this example is the lower right one of the array and there is a Leader Bar:
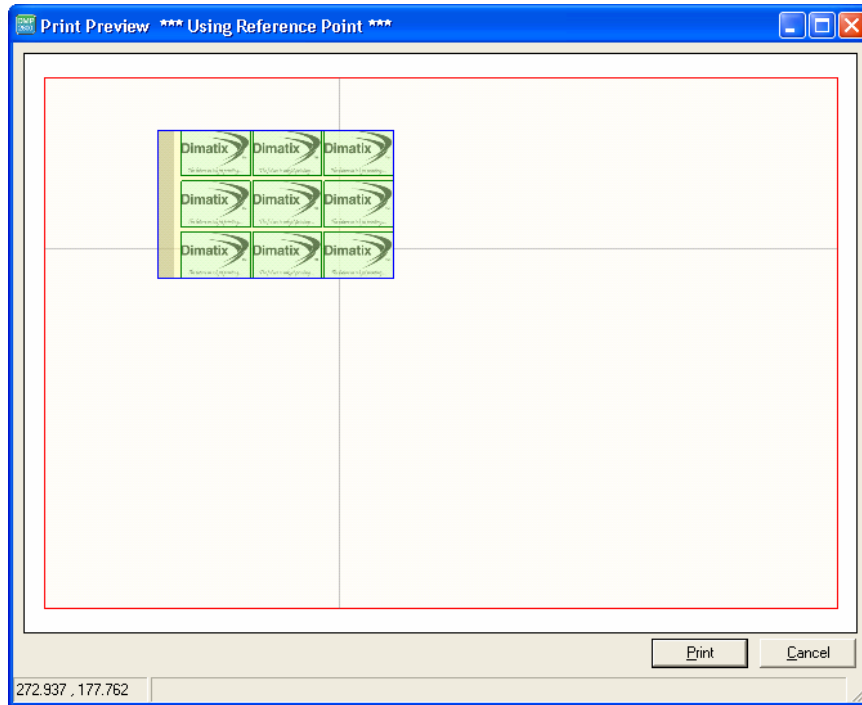
This example shows a Tiled array, using a Print Origin, without a Leader Bar:

Pattern with x/y start offset, tiling, using print origin (all patterns use the print origin):
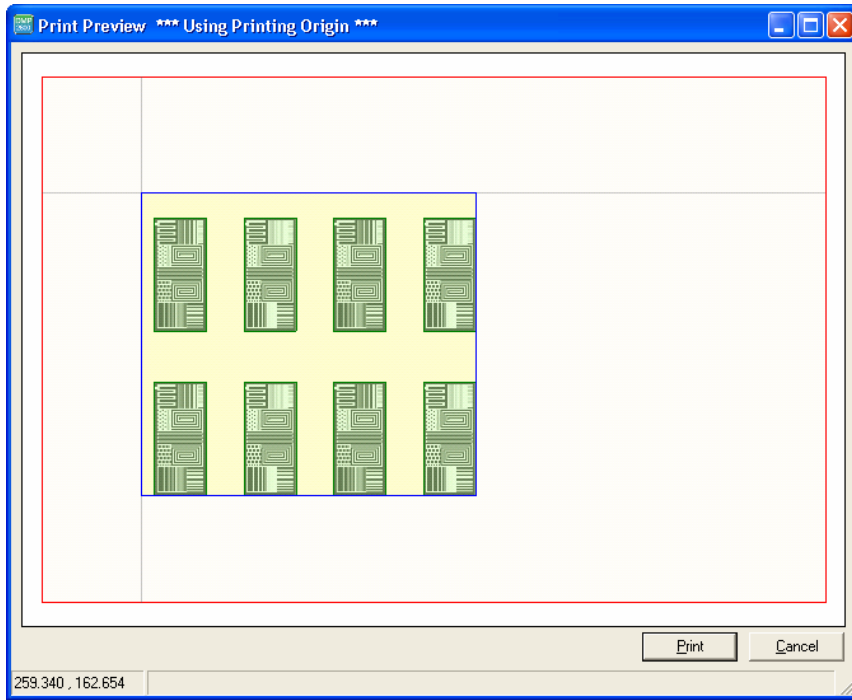
A tiled image with a bad reference point:
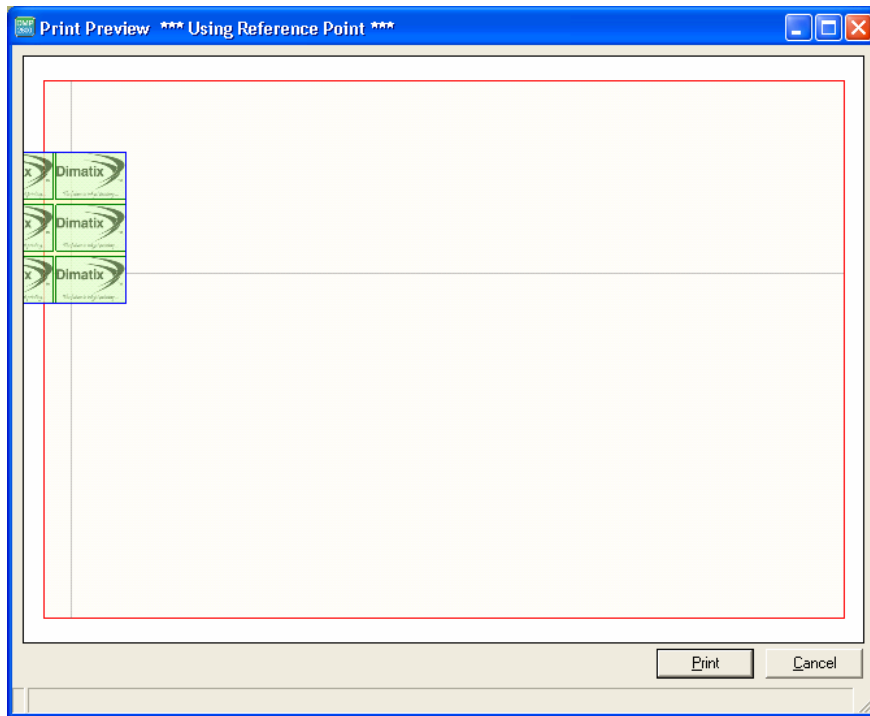
The error message you get if you try to print from an origin that takes the image off the printable platen area:
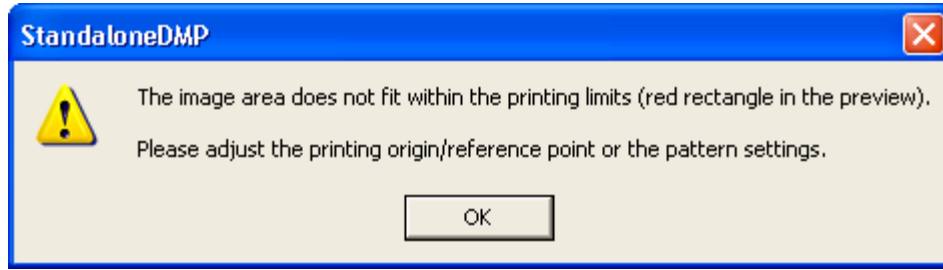
Cartridge Mounting Angle

Before you jet your pattern, the system will calculate the angle to set the cartridge determined by the Grid Spacing specified in the pattern. This angle adjustment is what allows the user to modify the drop spacing in the Y axis.

The following is a top view of the carriage. There are two sets of scales. The outer scale is the cartridge angle scale, and the inner scale is the vernier scale to adjust the head angle to 0.1 degree increments. Release the latch by pulling it forward freeing the carriage plate to rotate.

Latch
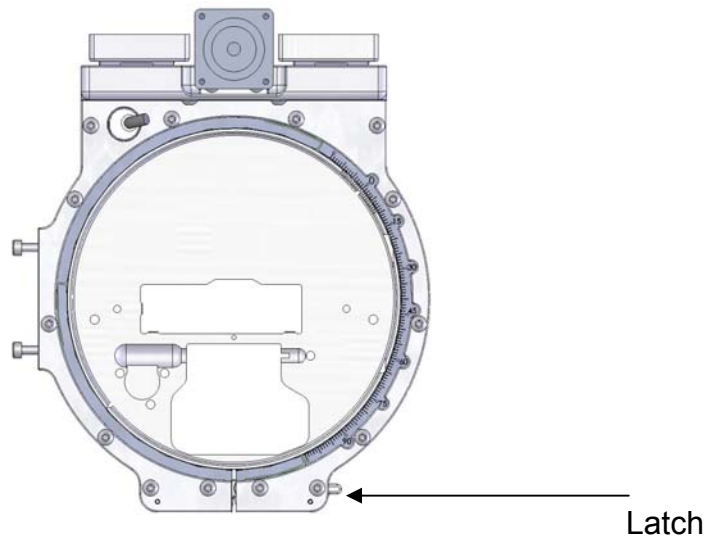
The following is a close-up of the cartridge angle alignment scale set to 0 degrees. The outer main scale is in one degree increments. There is a notch on the 0 point of the inner vernier scale is lined up with the 0 on the outer cartridge angle scale.
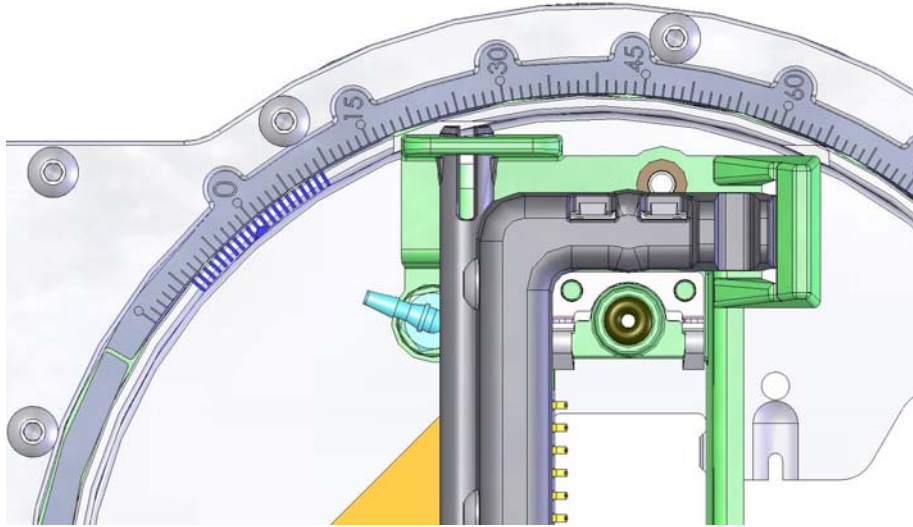
The following picture shows how to set the cartridge angle to 11.4 degrees. The 0 notch on the inner vernier scale is a little past the 11 degree mark. The next inner mark on the vernier that is lined up with a mark on the outer ring is line 4. This gives 11.4 degrees. If you wanted to set the cartridge angle to 11.5 degrees, then you would move the inner ring a little more to get the 5th mark lined up with a mark on the outer ring.
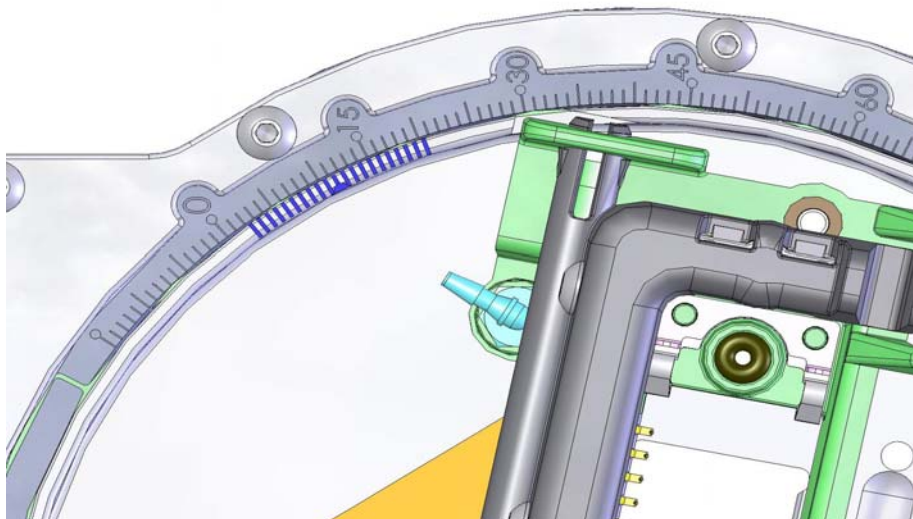
Drop Watcher

In the bottom left of the screen is the **Drop Watcher** button. Clicking on it will move the carriage to the right side of the platen, positioning the jetting cartridge's nozzles over the Drop Watcher Camera system. This system allows direct viewing of the jetting nozzles, the faceplate surrounding the nozzles, and the actual jetting of the fluid. The Cartridge **Settings** window also comes up at this time to allow you to modify the drive waveform and view the changes in jetting characteristics.

**Note:** Tickle control will be not active (displayed in gray) when you open the cartridge settings window via the Drop Watcher. In order to be able to change tickle control, open the cartridge settings window directly by clicking the edit button in the print setup tab in the DMP main program.

Once the carriage and cartridge are in position, click on the **Viewing Nozzle** box – number 8 should in the box. When you click on it, the system will bring nozzle number 8 of the cartridge into the center of the screen. You can then increment up or down to different nozzles and the system will move that nozzle into position in the screen. There is also a list of the nozzle numbers across the screen in which you can turn any of them on or off. By clicking the box associated with each nozzle it will fire that nozzle or turn it off. To minimize spraying off of the absorbent Drop Watch Pad, the user interface limits selecting jetting nozzles to the four surrounding the Viewing Nozzle.

If you want to do a maintenance cycle to improve jetting, you can do that by clicking on the **Run Now** button on the **Cleaning** box.
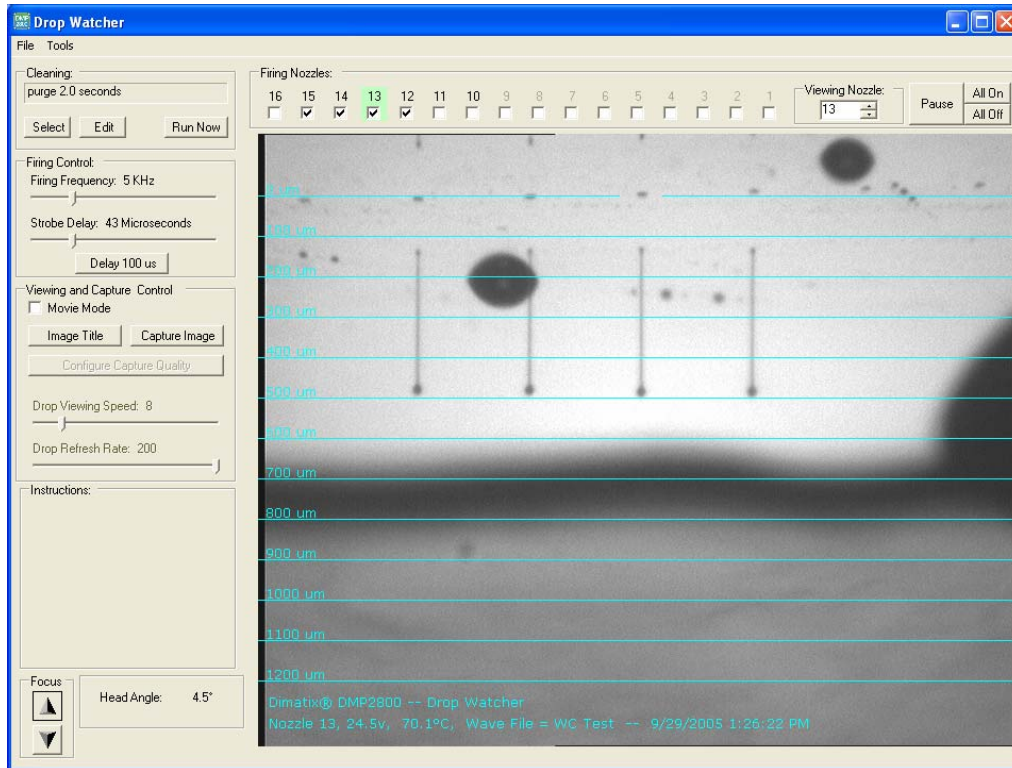
There are also two arrow buttons near the bottom left of the screen, which allow you to focus the camera on the nozzles and drops by clicking repeatedly until the image is in focus.

The drop watcher system provides you with two different viewing modes, selected under **Viewing and Capture Control.**

- If you click on **Movie Mode** box, this allows you to watch a stroboscopic "movie" of drops in flight as they are ejected from the nozzle. This is real time continuous firing of the nozzles. Clicking this box also changes the **Image Title** and **Capture Image** to either Image or Movie.

- If **Movie Mode** is not checked, then the drops appear to be frozen in flight for closer inspection and measurement. By adjusting the strobe delay you freeze the drop at different positions after it leaves the nozzle.

- You can click on the various nozzles to see how they perform.

- In **Tools** there are different versions of the video window's Graticule or scale available.

- The **Image/Movie Title** button allows you to put a title at the bottom of the screen in the image after "Dimatix DMP2800" – *Your Title Here*. The nozzle number that you are viewing, the firing voltage, the cartridge temperature, the waveform file name, and the date and time are automatically stored on the image.

- Under **Tools**, the **Display Image Information** allows you to turn on or off the image information.

- The **Capture Image/Movie** button allows you to store a still image video of the jetting with all the conditions information on it.

- When in **Movie Mode** the **Configure Capture Quality** button allows you to adjust the quality (and subsequently the file size) of the image by clicking on the **Settings** tab in the window that pops up. The dialog displayed will depend on the type of video interface installed in your system. A system with a Pinnacle Dazzle card (which is an external video device) will display the following:
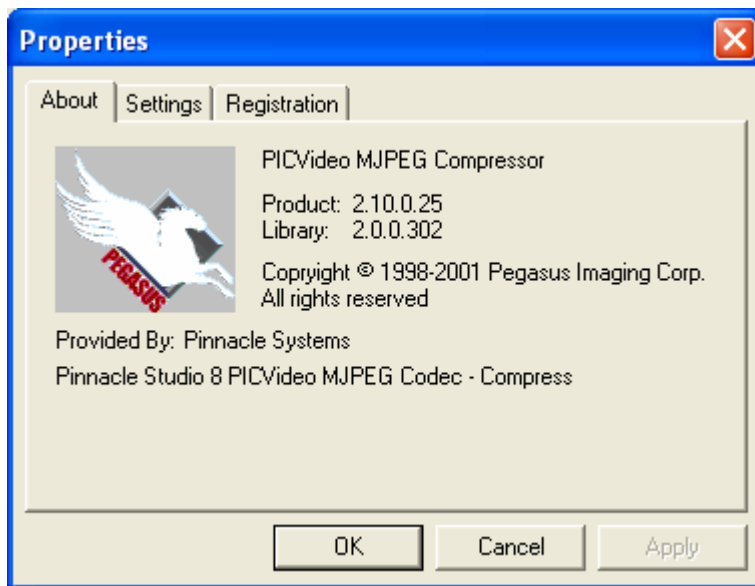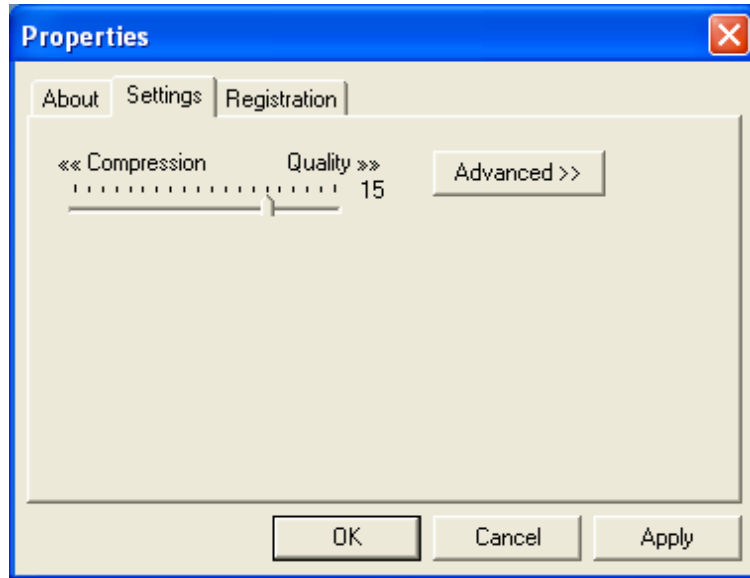
If a PCI video capture card is installed internal to the PC, the following will appear:

- The **Drop Viewing Speed** slider changes the sweep rate of the delay of the strobe while in **Movie Mode**. This has the effect of making the appearance of drop formation go faster or slower.
- The **Drop Refresh Rate** slider adjust the time at which the sweep delay starts over thereby adjusting how long you see a drop in flight.

The **Firing Control** box allows you to adjust the **Firing Frequency** while you are jetting to observe the effects by clicking on the slide the bar with your mouse and dragging it. The minimum frequency is 1 kHz.

- The **Strobe Delay** lets you set the time after the drop fire pulse at which the strobe LED fires to capture the drop image. This can be adjusted with the slide bar also.

This has the effect of freezing the drop in flight. Clicking on the **Delay 100 us** button automatically sets the delay to 100 us after the fire pulse. When you set the nozzles on the 0 um line on the screen with the Graticle on you can measure drop velocity. For example, with a 100 usec strobe delay you are seeing the drop after it has traveled for 100 usec. If the drop is at the 500 um line then the drop's velocity is 5 meters per second. This feature will come in handy when switching cartridges as you will want to match drop velocities by adjusting voltage to the nozzles to get consistent results. A good velocity to set is between 7 – 9 m/sec.

The **Tools** tab for this screen lets you select different features.

- o **Graticule** – This places a scale on the screen for velocity and drop formation measurements. The choices are: **None**, **Left**, or **Full**. Click on the one you want to use.
- o **Calibrate Nozzle View** – This feature automatically controls the stage motion to keep the nozzles in line when drop watching regardless of the cartridge angle. To perform this operation follow the following procedure:
  - – Start by clicking on **Calibrate Nozzle View**.
  - – The screen image should be close to nozzle 1. Find nozzle 1 (the rightmost orifice), put mouse pointer on the nozzle and click-drag it to the cross-hair on the screen. Use the focus buttons as necessary to refine the nozzle's focus.
  - – Click the **Next** button and drag the image to the right until nozzle 16 (the leftmost nozzle) is under the cross hair. Use the focus buttons again as necessary to refine the nozzle's focus.
  - – Click **Next** again and you are done calibrating the nozzle view. Now, when you select any nozzle from one to sixteen, the selected nozzle should be close to the 0 line opening, and in focus.
  - – For the stage to move the selected nozzle into position you must index through the nozzles using the **Viewing Nozzle** box. When you open the drop watcher it will try to center nozzle #8 in the middle of the screen and put nozzle 8 in the Viewing Nozzle box. By clicking the cursor in the box it turn the nozzle on and move it up to the 0 line.

- o **View Cartridge settings –** this allows you to open the cartridge settings form if they were closed.
- o **Drop Volume Measurement -** this is a procedure that will allow you to measure drop volume by using an average drop weight technique.

   The flowing screen shots show the procedure as it appears on the system when you are running it. You begin by opening the Drop Watcher window:
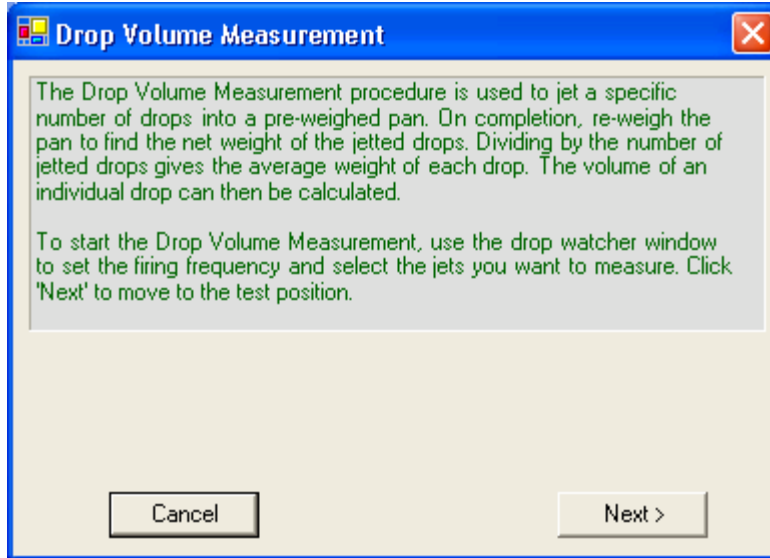
The following note explains to wait until the carriage moves into position and stops. A general note to remember he is that the DMP lid is the safety interlock. Opening the lid during any system motion will cause the system to re-initialize the motors.
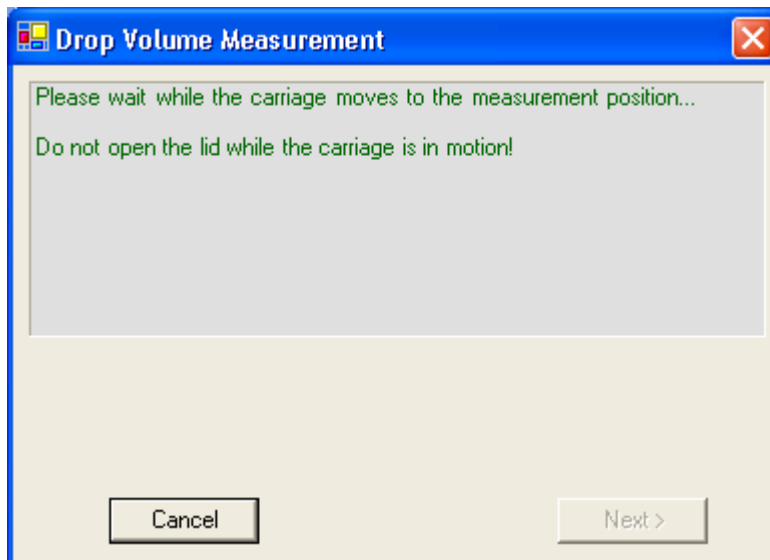
When the carriage moves over into position it is about 25mm above the platen surface.

Drop Volume Measurement

Please open the lid and place the pre-weighed pan under the carriage assembly.

Cancel   Next >
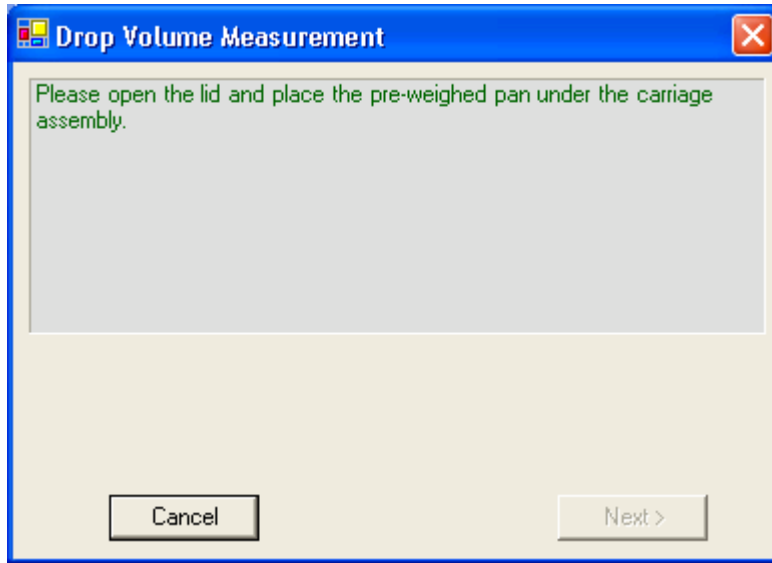
To begin with you need a container that you have weighed and that will fit under the carriage. It is best to use one that is shallow that the carriage can be lowered close to the bottom of it (to prevent drop lose from floating away).

Drop Volume Measurement * lid open ***

Place the pre-weighed pan centered under carriage.

Close the lid to continue.

Cancel   Next >
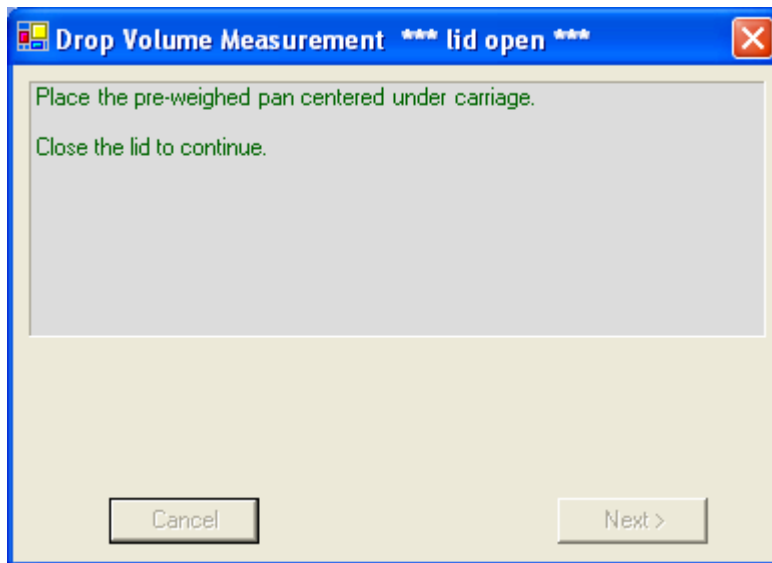
Adjust the carriage as close as you can to the bottom of the container. This will yield more accurate results.
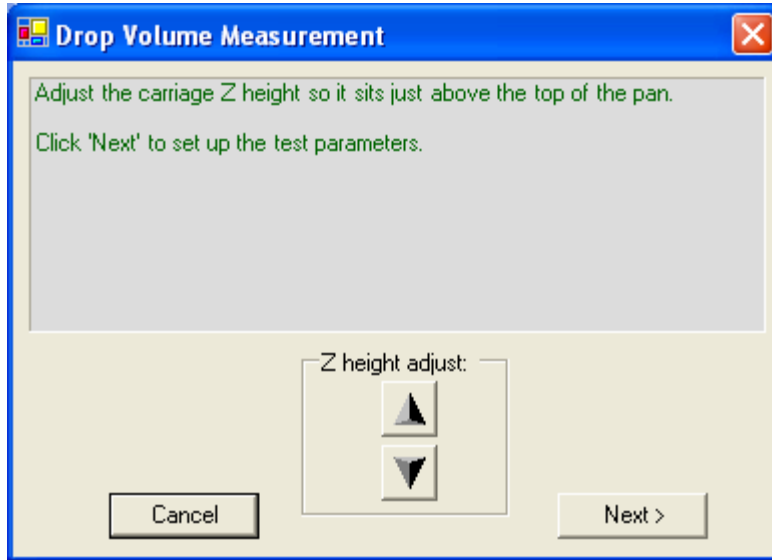
You want to weigh as many drops as practical to get a more accurate number. The number of nozzles you have selected to fire in the drop watcher before opening this menu will show up on the form. The frequency you set it the Drop Watcher will be the firing frequency for this procedure. The following form shows 7 nozzles have been selected. The default time period will be calculated based on the frequency and number of jets to get close to 1 million drops. Adjust the time to change the number of drops jetted.
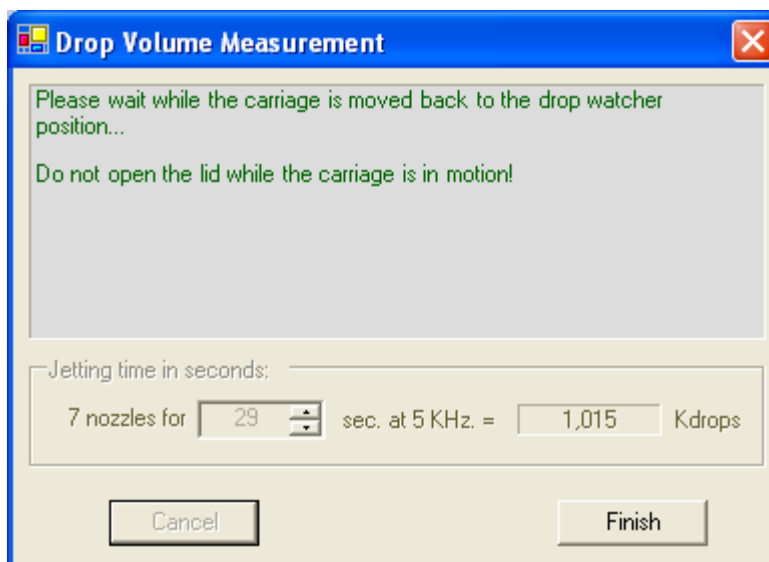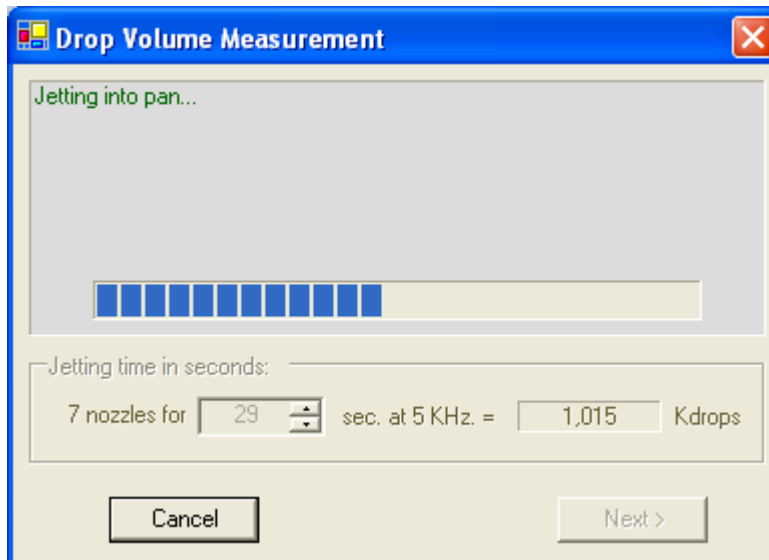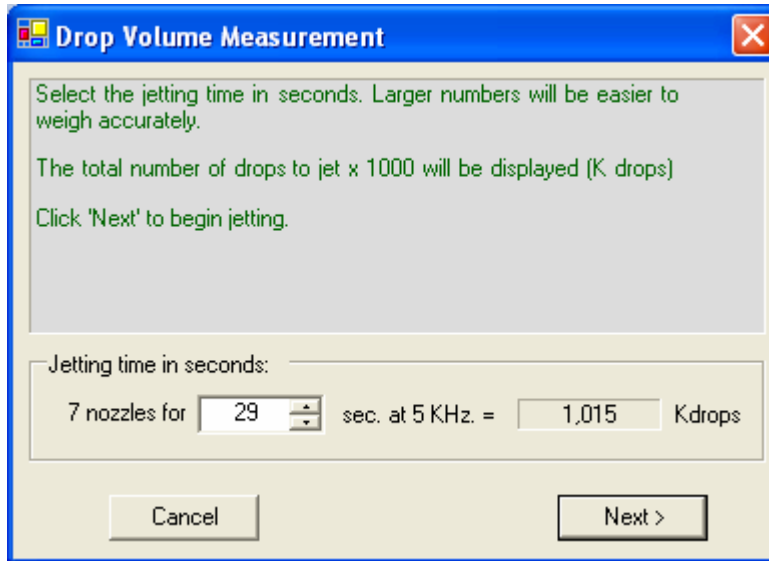
Once it finishes jetting you are ready to calculate the drop mass after weighing the pan.
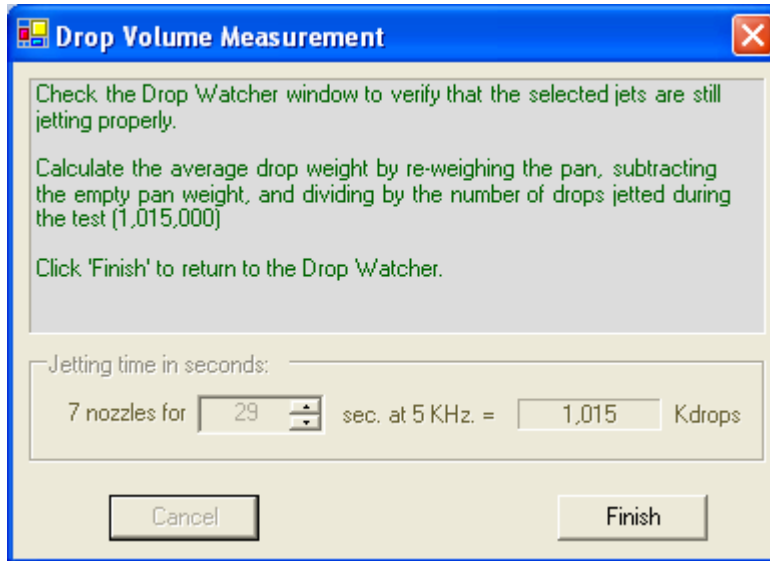
Drop Watcher Pad

The Drop Watcher Pad is located in the center of the Drop Watcher mechanism and acts as the receptacle for fluid during jetting. It will need to be changed periodically as it absorbs fluid. Typically this occurs when you see stray drops being deposited on the nozzle surface during drop watching or fluid is covering the side of the Pad holder. To replace the pad simply pull out the holder and insert a new one.

Fiducial Camera

On the main **Dimatix Drop Manager** window go into the **Tools** menu and select **Fiducial Functions** or click on the **Fiducial Camera** button.
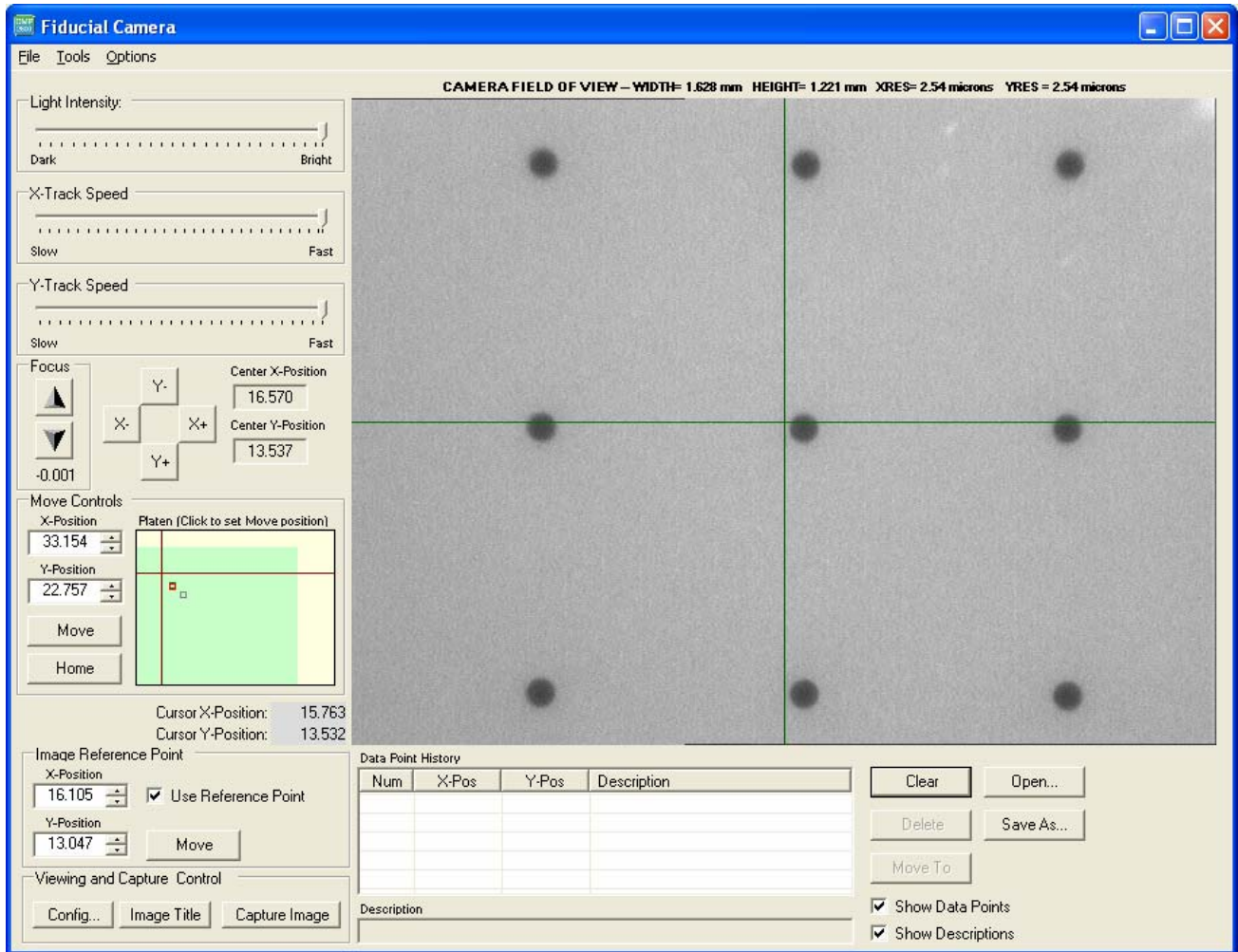
The above image is a sample screen shot of the main **Fiducial Camera** window. The fiducial camera feature is used when you want to deposit a pattern on a pre-patterned substrate, patterned on the DMP but removed, or that you are jetting a pattern with a different material (cartridge) than with which the first pattern was created, or to view the printed features.

The information just above the image is about the **Camera Field of View**. This currently is a width of 1.62 mm and a height of 1.22 mm with a resolution of 2.54 microns per pixel.

Features

- **Light Intensity** – This slider allows you to adjust the light intensity of the camera to optimize the contrast of the image.

- **X-Track Speed** – With this slider button you can adjust the movement speed of the stage in the x axis when aligning and making measurements. This adjustment is done by placing the mouse curser on the slide and dragging it to the desired speed.

- **Y-Track Speed** – With this slider button you can adjust the movement speed of the stage in the y-axis when aligning and making measurements. This adjustment is done by placing the mouse curser on the slide and dragging it to the desired speed.

- **Focus** – These two arrows allow you to focus the camera up or down. The number in the bottom of the **Focus** box is the height in mm from the last set focus origin that the camera is currently focused to. This feature allows you to make Z height measurements if you want to. The focused Z height is about 32mm above the substrate. When using the fiducial camera you can only print on a **maximum substrate thickness of a 25 mm**.

- **Y-, Y+, X-, X**+ – These buttons allow you to move the carriage to any position simply by clicking on the button corresponding to the direction you want to go.

- **Center X- Position, Center Y-Position** – This is the position in mm of the center of the crosshair displayed on the screen relative to the last set Print Origin.

- **Move Controls**
  - o **Platen** – The "*yellow area"* is the area where the camera can view a feature. The "*green area"* **is where you can set a Print Origin point**. The *red cross-hair* in the platen box window displays the position of the **current Print Origin**. The *red box* in the window shows where you are currently viewing on the platen and the *grey box* indicates the position of the coordinates that are in the X-Position and Y-Position boxes. If there is a *green box* that shows you the position of the image Reference Point you have selected.
  - o **X-Position, Y-Position** – These boxes have two ways to operate. You can either enter a number into the boxes and then click the **Move** button and the camera will move to that position, or place the curser in the green area of

the **Platen** box and click on a location and then click the **Move** button and the camera will move to that point and its coordinates will be displayed in the boxes.

- o **Home** – Clicking on this button moves the camera back to the Print Origin.

- **Cursor X-Position, Cursor Y- Position** – This box tells you the position of the cursor relative to the print origin in either the displayed image or in the **Platen** box.

- **Image Reference Point** – The position of the **Reference Point** you have selected relative to the selected **Print Origin**. This is the physical point on the substrate that you want to align a BMP or Gerber file to for printing. This is only used for BMP and Gerber images and not Dimatix Pattern generated files. See BMP printing for more information.

  - o **Use Reference Point –** By checking this box the DMP will position the pattern's reference point to the **Image Reference Point**. It will do this <u>only</u> with the Fiducial Camera window open. If you do not use the reference point the image will be printed from the print origin.

- **Viewing and Capture Control** – This box allows you to configure the video device and capture the displayed image similar to the Drop Watcher Image capture feature.

  - ▪ **Configure** – The configuration should be as shown in the window below. The "Dazzle" device should be selected if your system was delivered with one, or the Hauppauge Card should be selected if your system was delivered with an internal video card
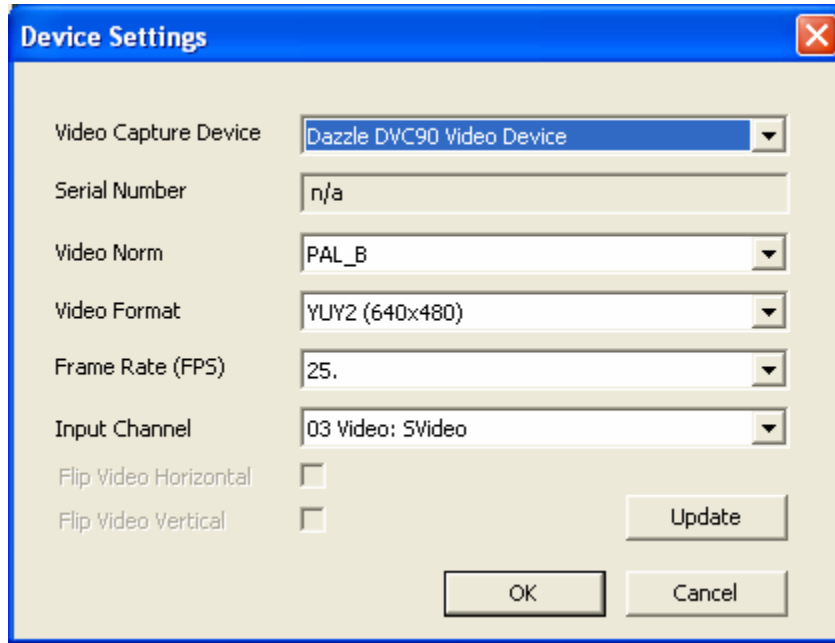
- ▪ **Image Title** – Click on this to open the box as seen below to type in a name for your image.
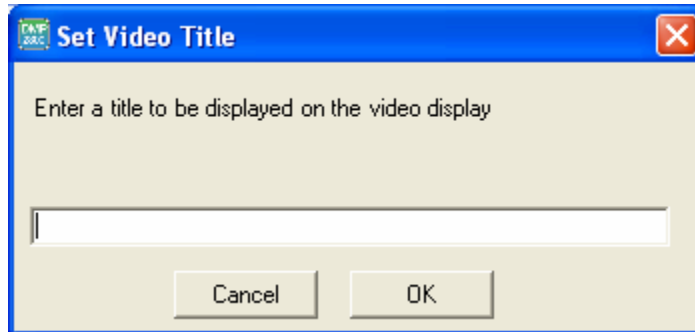
- ▪ **Capture Image** – Click on this to save the image in a file of your designation.

- o **Data Point History** – This box allows you to select any points in your pattern and save them in a file for future reference or for analysis in an Excel spreadsheet. Simply place the cursor on the point you wish to capture and click on it. The x & y position will go into the table. If you click on the line of data in the table you can then enter a description of that point if you desire. By clicking on the **Show Data Points** or **Show Description** boxes you can turn those on or off.

Alignment Procedures

When you first click on **Fiducial Functions** from the **Tools** menu on the **DDM** window the camera goes to the last Print Origin. The **Center X-Position** and **Center Y-Position** boxes will show you where the crosshair is relative to the origin. If it is slightly off you can click on **Home**, and it will move closer to the origin point.

Tools Menu **in the Fiducial Camera Window**

- **Set Print Origin** – This feature is to set the origin of your pattern.
    - When you click on the **Set Print Origin** the following window pops up.

Set Printing Origin

The print origin defines the upper left-most print position on the platen. Patterns are printed based off the print origin and can not print above or to the left of the print origin. Typically, the print origin is set to the corner of the substrate or a specific feature on the substrate.

Use the Fidicial form's X/Y controls to navigate to the position. Click on the position in the Fiducial form's video display to set the new print origin.

Cancel

- With the Fiducial camera open, move the camera to the point you want to be the origin. Place the cursor on the image and click on the point you want for the origin. That will be the origin from which other measurements will be made and from which the pattern you choose to print will originate from. When you click on your point, the crosshairs and camera will center on that point. You cannot set an origin on the lines scribed in the platen. The location which will allow you the **largest printing area is about 7mm down from the X line and about 4mm to the left of the Y line**.

- **Set Focus Origin** –Use the arrow buttons to focus up or down and then click on this feature in the **Tools** menu.
- **Set Reference Point** – This is used to set the physical reference point for an Image Reference Point you may have selected. The image will be aligned so that its reference point is printed at this location on your substrate.

o When you click on the **Set Reference Point** the following window pops up.
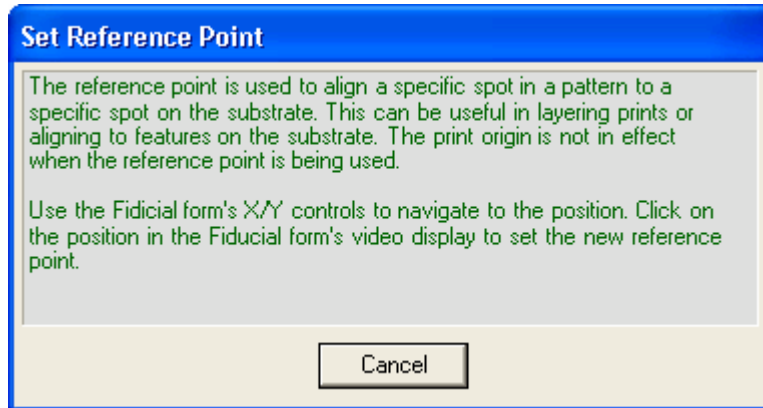
o Similar to setting a Printing Origin, move to the position on the substrate you wish to use, then place the cursor on that point on the view image and right click. The up/down arrow buttons on the reference point's X-Position and Y-Position boxes can be used to adjust the point.

o You **must** check the "Use Reference Point" box on the Fiducial Camera window, and you **must** leave the camera window open to print the image using the Reference Point feature. (*Refer to BMP and Gerber File Printing for more info).*

- **Set Drop Offset** – This feature is used to calibrate the position of a new or different cartridge to the previous printed pattern. **This procedure is very important and must be done when trying to precisely match patterns or place drops in precise locations.*

o In an area outside your printing area of concern, you will jet a pattern where you can locate one drop. The pattern will be printed with the nozzles you have selected in the Cartridge settings you are using and consists of a line with a single dot after it.

o When you click on **Set Drop Offset** in the **Tools** menu the following window pops up.

o To start you must have the cartridge set to the angle required by your pattern.

Set Drop Offset

The Drop Offset is used to calibrate the positional accuracy of a new cartridge or head angle.

The calibration involves printing a pattern then using the mouse to select a specific drop from the pattern.

Before starting, make sure you have adjusted the head angle and cartridge settings. Click 'Next' to begin.

Cancel   Next >
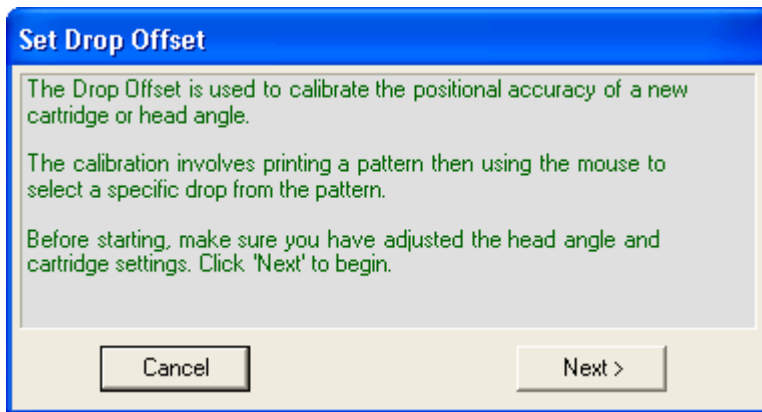
Move to position where you can print the test pattern and place the cursor on the screen and click to select the start location.

Set Drop Offset

Use the Fidicial form's X/Y controls to select a location to print the drop offset test print. The print requires a space that is 16mm wide by 1mm tall.

Click on the location in the Fiducial form's video display at the desired location to start the print.

Cancel   Next >

Set Drop Offset

Printing the drop offset test pattern.

Please wait...

Cancel   Next >
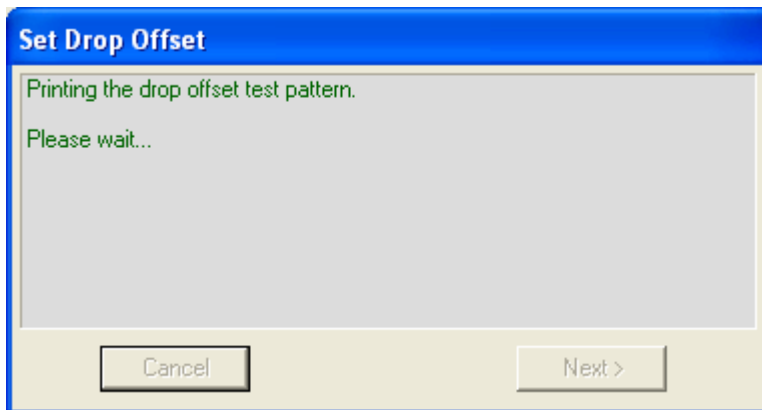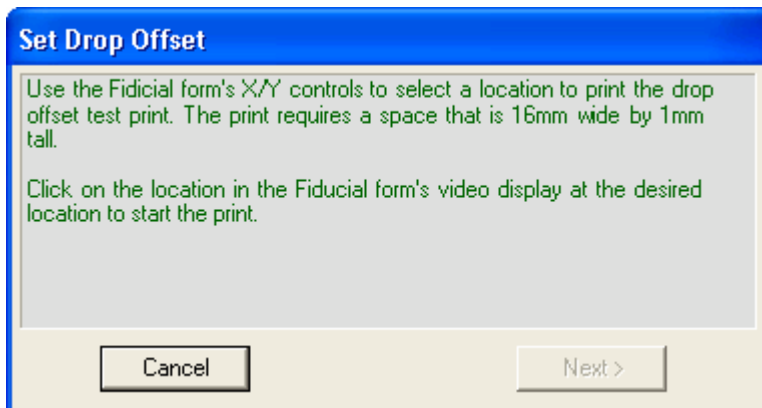
After the test pattern is printed locate the single spot with the Fiducial camera and find and click on it.
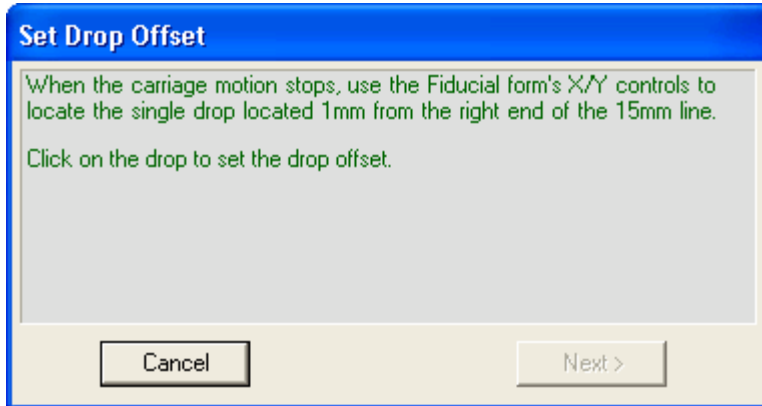
It should look something like the following image:
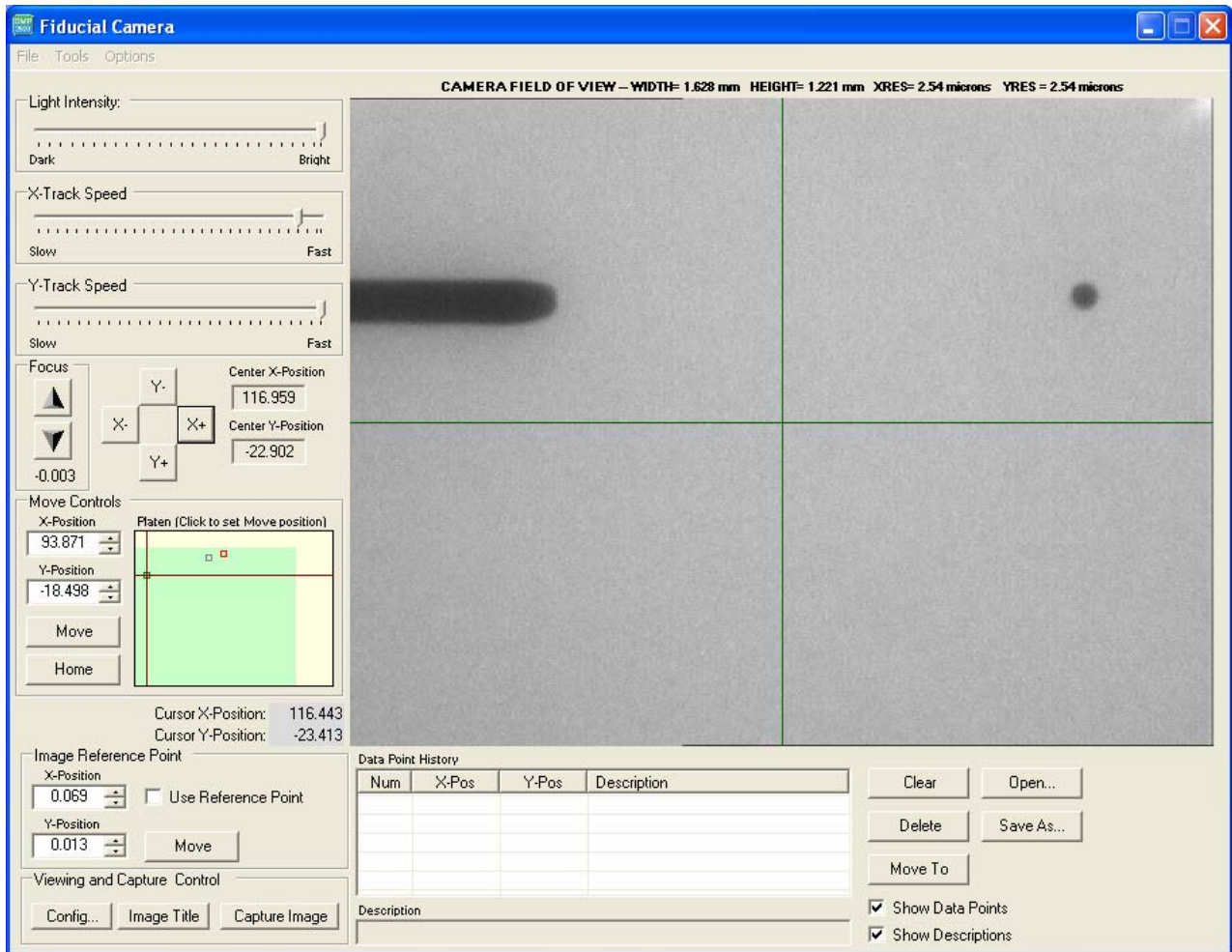
This routine is now completed:

Set Drop Offset

The drop offset has been set.

Click 'Finish' to continue.

[Cancel]   [Finish]

If the Drop Offset is determined to be outside the normal range it will need to be repeated after verifying that the first nozzle selected in the cartridge settings is firing properly and that the cartridge is positioned well in the holder.

Set Drop Offset

The drop offset is outside the allowable range. This can occur if the correct drop was not selected, the cartridge is not seated properly, or the the cartridge is not jetting well.

Click the screen to reselect the drop offset point or 'Cancel' to check the cartridge.

[Cancel]   [Next >]
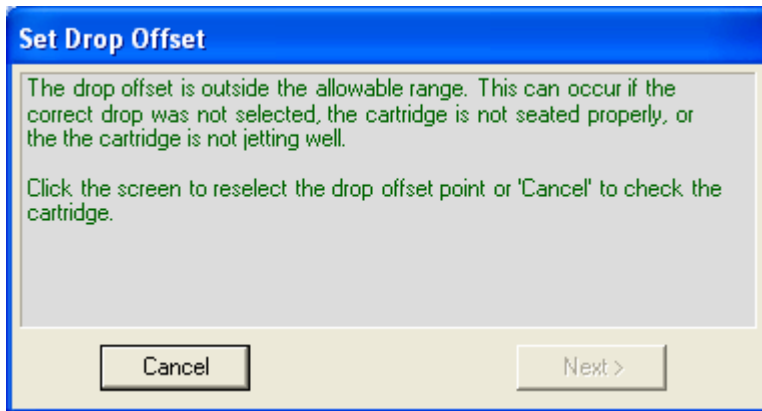
This has now adjusted any positional offset from the newly installed cartridge to Fiducial camera which you set the Origins and Reference Points with.
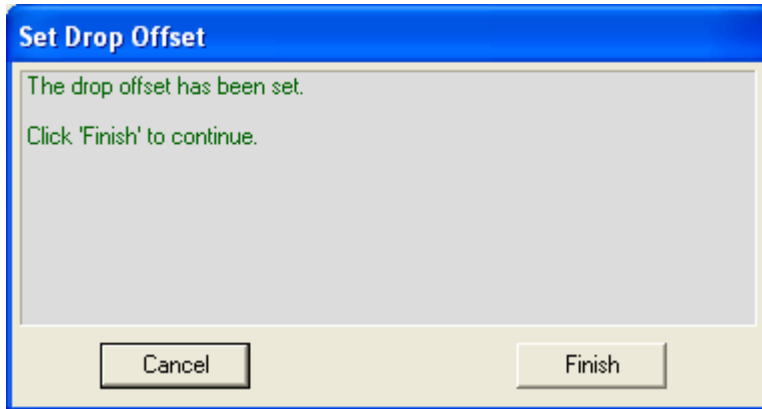
- **Set Drop Offset (Manual)** – This is used to calibrate a new or different cartridge by creating your own pattern. This may be useful when jesting clear or difficult to see fluids.
    - o In an area outside your printing area of concern, jet a pattern where you can locate one drop. This can be a single drop pattern (which may be difficult to

find or see) or maybe a square of 5 drops (x&y) or a

"+" pattern that you can find with the camera.

- o When you click on **Set Drop Offset** in the **Tools** menu the following window pops up:

```
Set Fiducial Drop Offset                    _ □ X

Drop X-Carrriage Position (mm)      0.000   ↕

Drop Y-Platen Position (mm)         0.000   ↕

      Set Drop Offset              Close
```
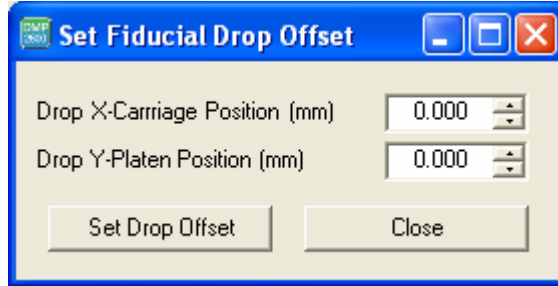
- o Enter the position of the dot you specified as the upper left dot in your Pattern Generator file.

- o Click on the **Set Drop Offset** button and the following window pops up:

```
StandaloneDMP                               X

On the Fiducial Video display select the position defined above.

            OK          Cancel
```

- o Click **OK**.
- o Then place the cursor on the center of the drop in the pattern that you just jetted and click.
- o This has now adjusted any positional offset from the cartridge to what the pattern file specifies.

- **Calibrate Theta** – This feature allows you to compensate for an angular offset that you might have on the substrate or pattern that you have placed on the platen. To calibrate:
  - o Click on the feature in the **Tools** menu and the following window pops up:
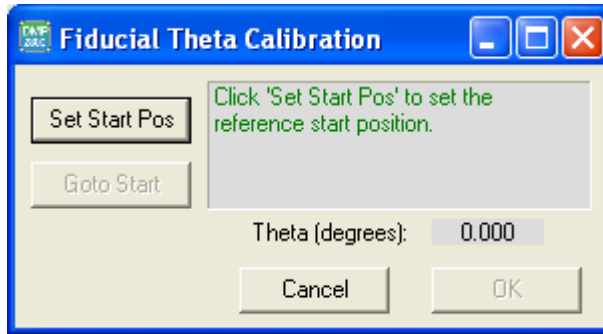
o Follow the instructions and click on the **Set Start Pos** button and the following window pops up:
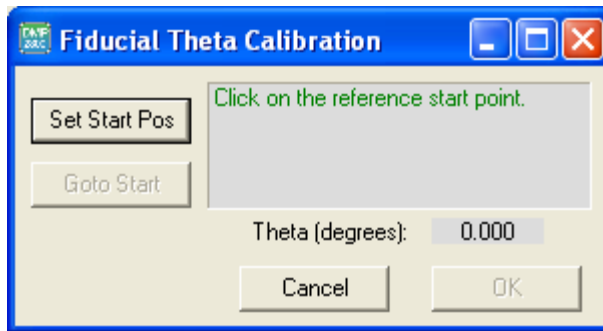
o Click on the first point you want to use on the fiducial camera image. The following screen then pops up:
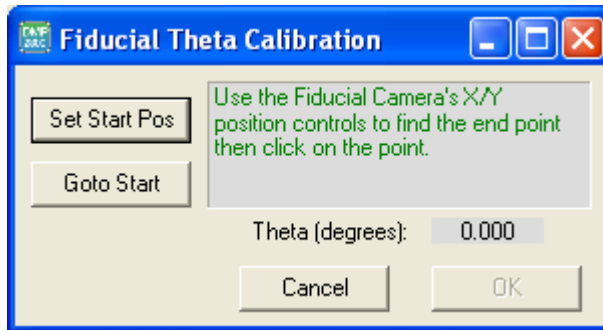
o Move to the next spot you want to use for Theta calibration by using the **X+**, **X-**, **Y+**, or **Y-** buttons on the **Fiducial Camera** window. If you are using a point far from your current position you may also **jump** there by pointing to it in the "green" area of the **Platen** in the **Move Controls** box on the **Fiducial Camera** window and clicking the **Move** button. You may also enter the coordinates in the **Move Controls** box and click **move**.

o After clicking on the second point the following window pops up. Click **OK** or **Cancel**.
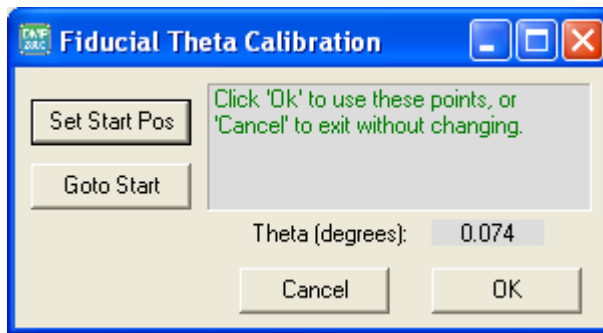
- **Calibrate Thermal Scaling –** This feature allows you to compensate for a substrate that has changed dimensions during a thermal process after printing, and you want to print on it again, or that changes dimensions significantly if heated while on the platen.
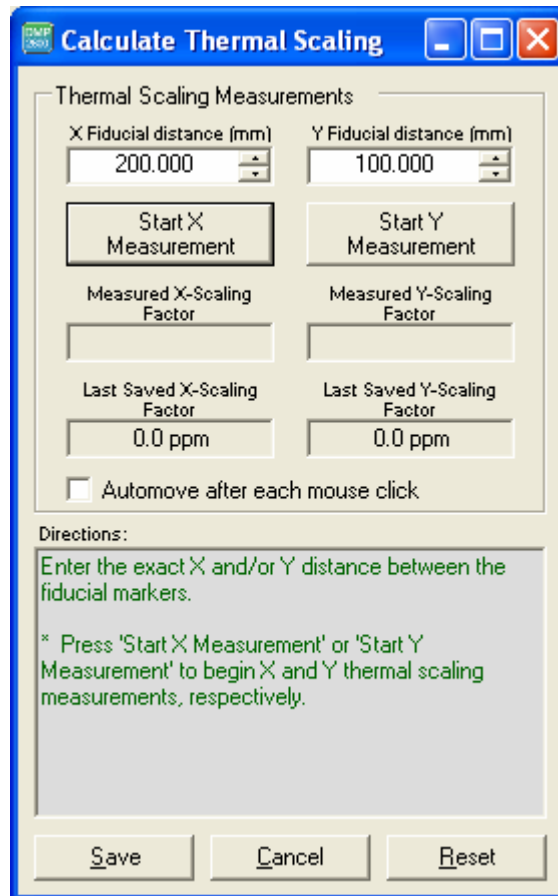
  - To start the thermal scaling process you start by entering the distance between your two fiducial marks on your substrate that you are going to use for the calibration.

- Locate your first mark with the fiducial camera by moving it into position over the mark.
- Click on the **Start X** (or Y if you have only Y direction marks) **Measurement**. The button will turn green and say Cancel if you want to cancel and start over.
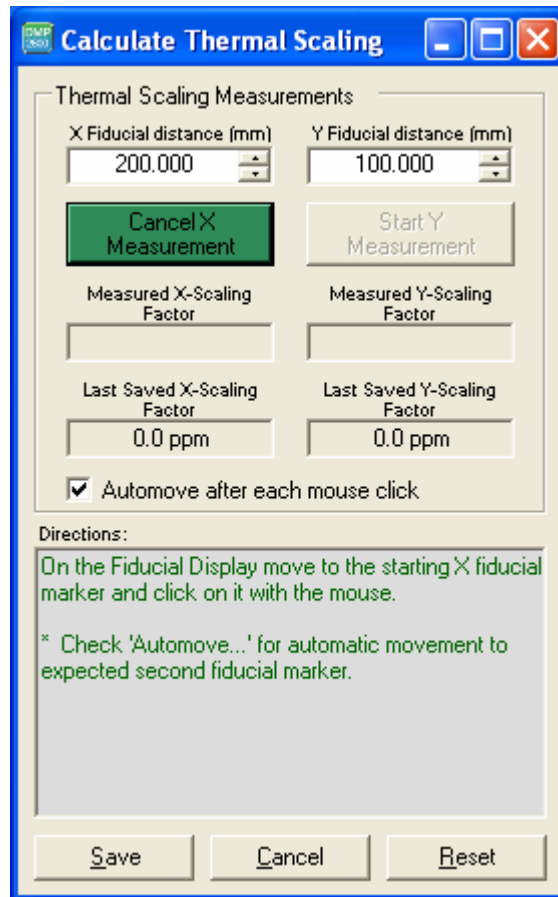
- With the **Automove** box checked the fiducial camera will automatically move in the direction you are calibrating the distance entered in the box.
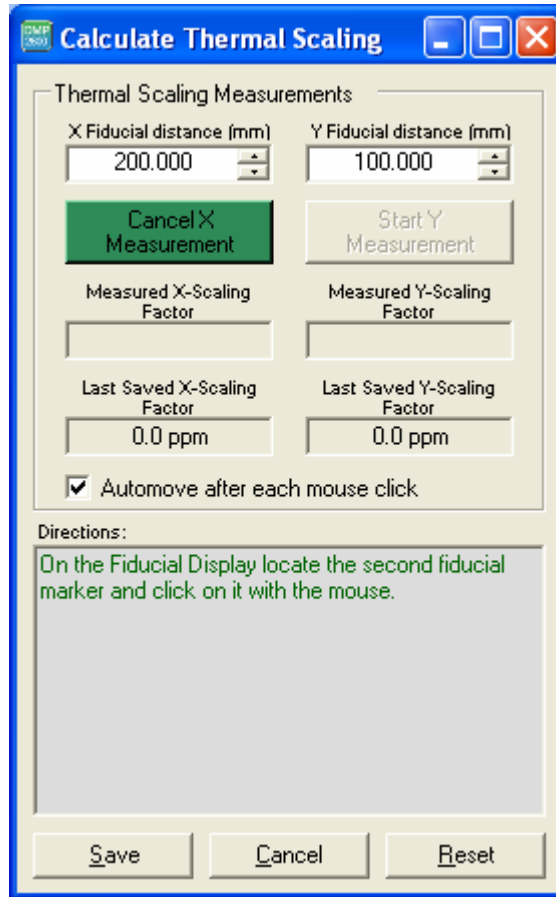
o   When the camera stops at the indicated position, place the cursor the second mark and left click the mouse. If you don't see the feature in the image area move the camera with the x & y motion controls to locate it.

- o Now you will want to repeat the procedure for the other axis (Y or X) if you have marks for that axis also.
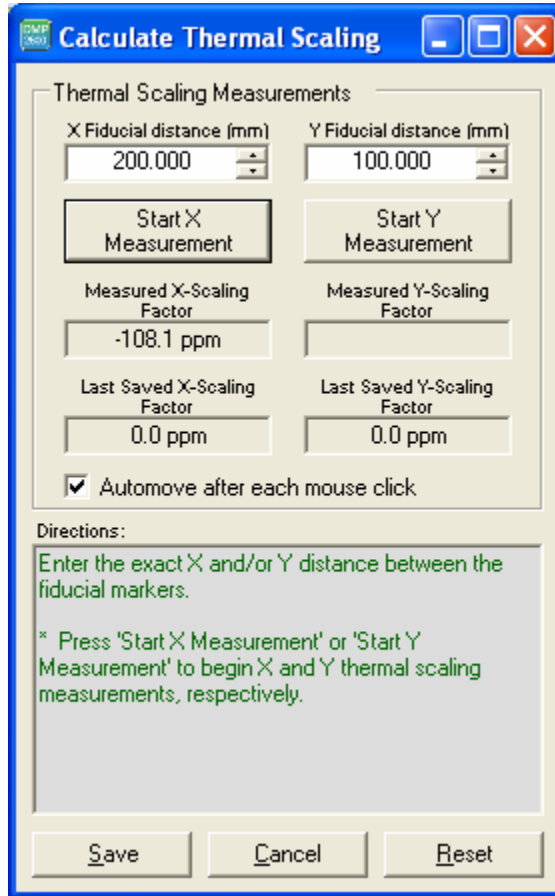
- o When you have completed the calibration click the save button and you will now be ready to jet your pattern that will be corrected to the new size of your substrate.
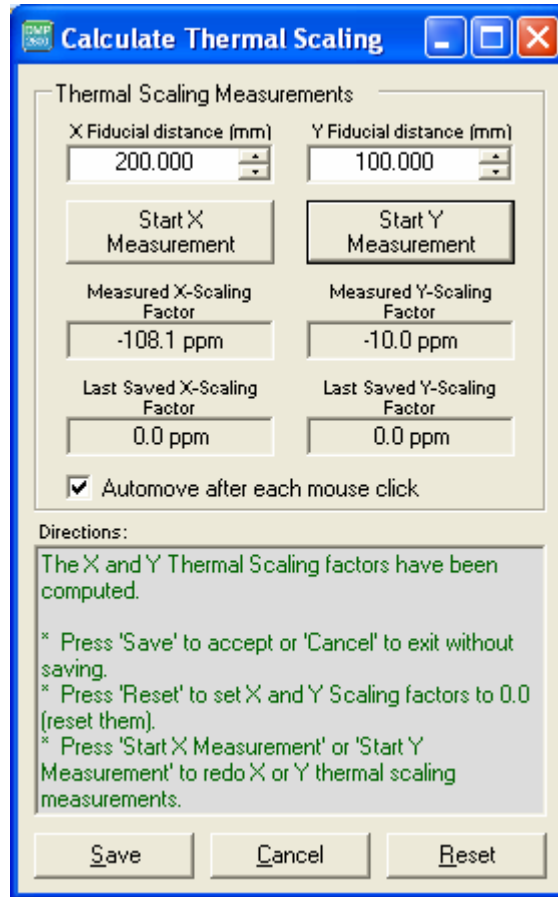
- **Measure Cartridge Angle** – This feature is used in conjunction with the **Print Cartridge Angle Pattern** in the **Fiducial Functions File** menu. Occasionally you may experience gaps in your printed image. This may be a result of not setting the cartridge angle precisely enough and it may need adjusting. This is the procedure to tell you how much you are off and which way to correct it. Follow the instructions in each window.
    - o In the Fiducial Camera window file menu select Print Cartridge Angle Pattern. A pattern with horizontal lines will be printed. Find the pattern by moving the camera with the X, Y Motion Controls to that location. Follow the instruction in the window to calibrate the cartridge.
    - o Once the pattern is printed select **Measure Cartridge Angle** in the Tools menu of the Fiducial Camera window. Follow the instructions in the window.

Measure Cartridge Angle

Measure Cartridge Angle is used to measure the current cartridge jet angle and provide feed back for further adjustments.

The calibration involves printing two lines then using the fiducial form controls to select the lines. This measurement requires that jets 1 and 16 are functioning properly.

Before starting, make sure you have adjusted the head angle for the pattern you want to print. Click 'Next' to begin.

Cancel   Next >

An important note is that Nozzle 1 and 16 must be firing properly to achieve accurate results and that the cartridge angle must be set to the angle for your pattern.

Measure Cartridge Angle

Use the Fidicial form's X/Y controls to move to and select a location to print the Measure Cartridge Angle test print. The print requires a space that is 35mm wide by 5mm tall.

Click on the location in the Fiducial form's video display at the desired location to start the print.

Cancel   Next >
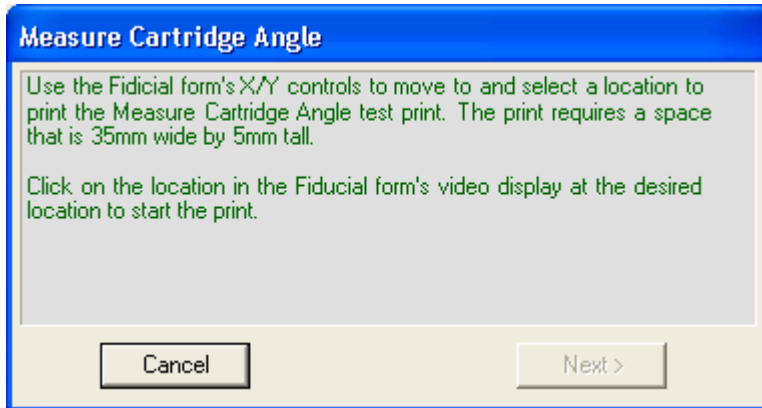
Move to a space where you can print he pattern or place a different substrate on the platen and place the cursor on the starting point on the screen and click on it. The system will then print the test pattern.

Measure Cartridge Angle

Printing the measure cartridge angle test print.

Please wait...

Cancel   Next >
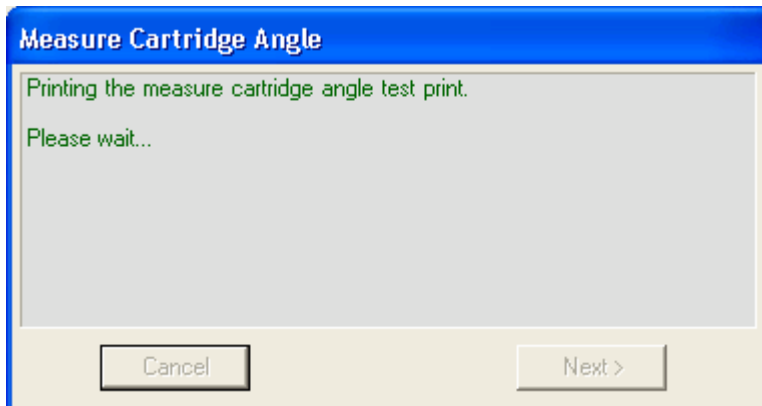
With the x,y motion controls, place the cross hairs on the center of the top line, click the next box, move to the bottom line, center the cross hairs on it and click the next box.

```
Measure Cartridge Angle

When the carriage motion stops, use the Fiducial form's X/Y controls to
locate the top line. Center the horizontal cross-hair on the line.

Click 'Next' to select the top line.

    [ Cancel ]                              [ Next > ]
```
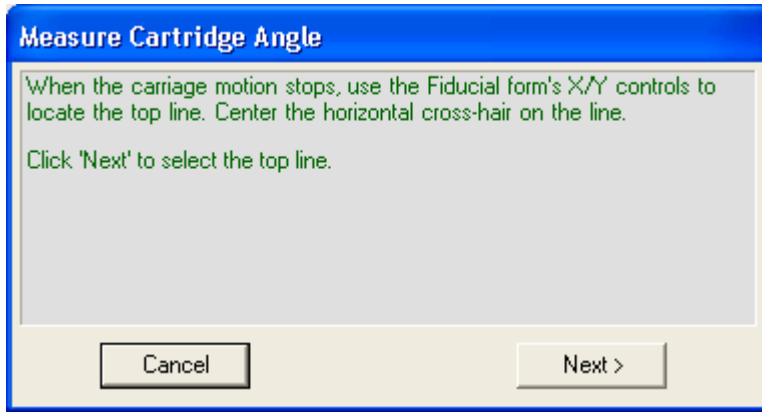
The following window is an example of the results from measuring the jet angle. It tells you the direction and how much to adjust the head to get better printing.

```
Measure Cartridge Angle

The measured cartridge angle is 6.24 degrees.
The last loaded pattern's angle is 5.88 degrees

Rotate the head 0.36 degrees counter-clockwise.

    [ Cancel ]                              [ Finish ]
```
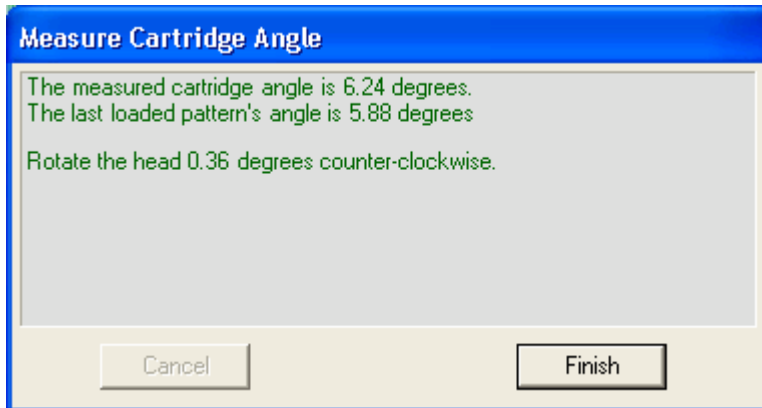
Click **Finish** when you are done.

Options menu in the Fiducial Camera Window

- **Measurement Mode** – Clicking on this allows you to make measurements of features or between features on your substrate. When you click on **Measurement Mode**, you simply click on one point and then the other and the distance between them will be displayed on the image.
- **Crosshairs** – This feature allow you to turn on or off the crosshairs displayed on the screen.
- **Text** – This allows you to add text to the image.

File menu in the **Fiducial Camera** window

- **Print Pattern** – This feature allows you to print the pattern selected on the main Drop Manager Window while in the fiducial mode.

- **Print Jet Angle Pattern** – By clicking this item a pattern of two rows of dots will be printed to be used in the Measure Jet Angle feature in the Tools menu. It prints the pattern at a location about 1mm in X and 4 mm in Y from the origin. You want to the pattern selected on the main Drop Manager Window form when this is run.

- **Exit** – Clicking on this allows you to exit the **Fiducial** Camera window.

Fluid Requirements

Some of the fluid physical characteristics to achieve optimum performance are:

- **Viscosity** – 10-12 centipoise at jetting temperature

- **Surface Tension** – 28-33 dynes at jetting temperature

- **Low Volatility** – Boiling points higher than 100 deg. C are preferred

- **Density** – Specific gravity greater than 1 is beneficial

- **Degassing** – Additionally the fluid may need to be degassed to remove any dissolved gas which inhibits jetting. Typical degassing can be done with a vacuum (a negative pressure of 2 psi for 1-2 hours maybe sufficient or up to only 50mbar), by using ultrasonic, or by spinning (fully miscible solutions only).

Refer to Dimatix Application Notes at www.dimatix.com for more information.

Dimatix Model Fluid MFL-002

This fluid is a non-toxic, non-hazardous, non-drying fluid used in our testing and qualify printheads and jetting assemblies.

- The **surface tension** is 33 (+/- 3.5 dynes/cm) at jetting temperature. A polymeric dye was selected to color the fluid.

- The jetting temperature for Model Fluid 2 is 30°C, resulting in a typical **viscosity** of 11 centipoise.

Drop Formation
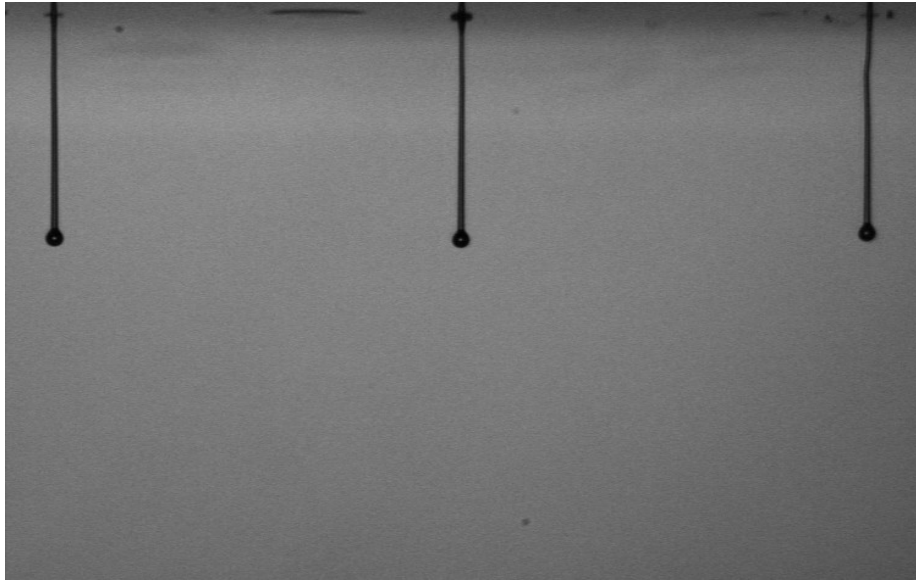
The following screen is a typical single pulse waveform such as one used for the Dimatix Model Fluid:
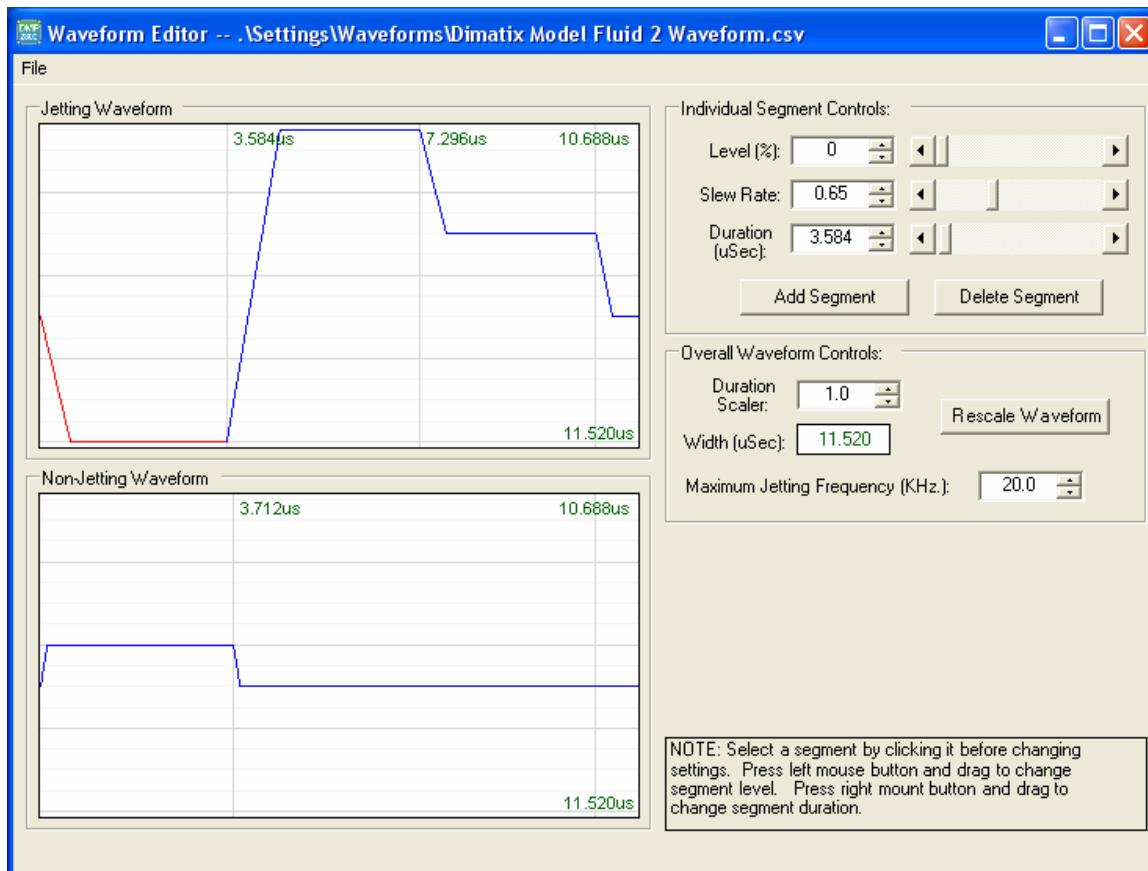
- *Refer to application note for tuning of various fluids*

The following are typical jetting results that the user may see from jettable fluids.

Drop Velocity vs. Frequency

Here you will see that higher viscosity fluids will have lower velocity and a better high frequency performance due to their dampening effect. Higher voltages to the cartridge are required for higher viscosities.
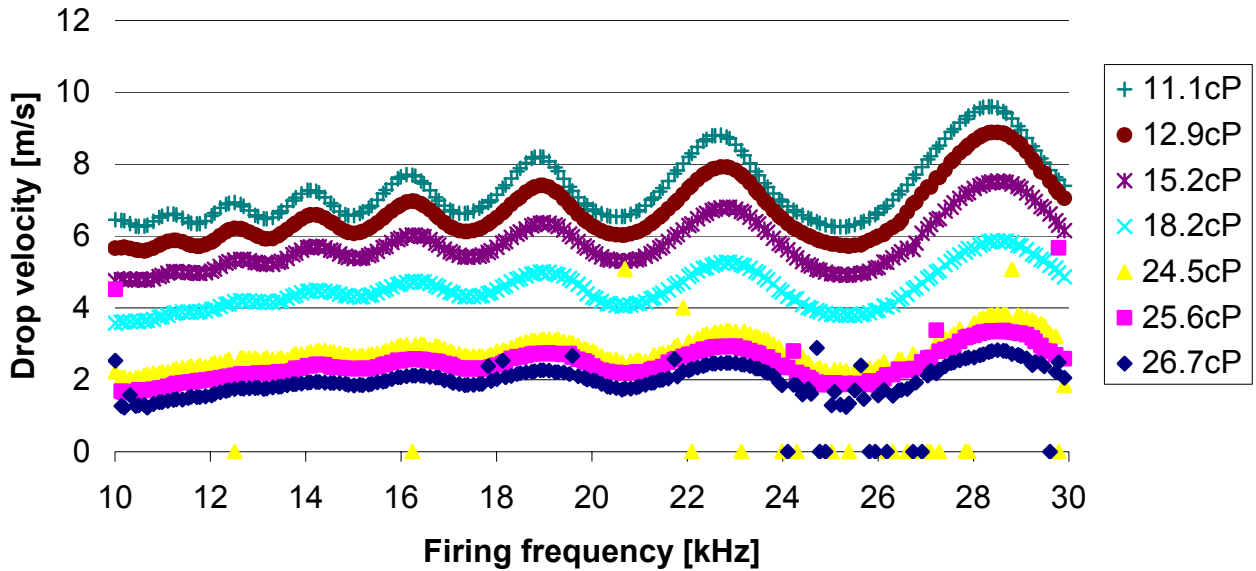
Drop Velocity vs. Voltage with different Viscosities
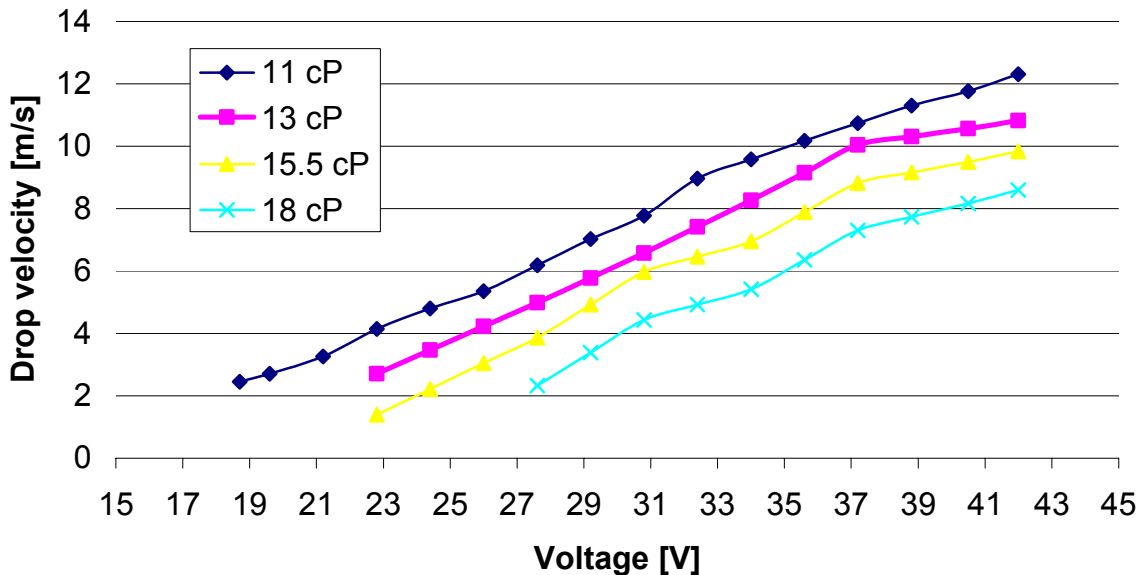
Voltage vs. Drop Mass
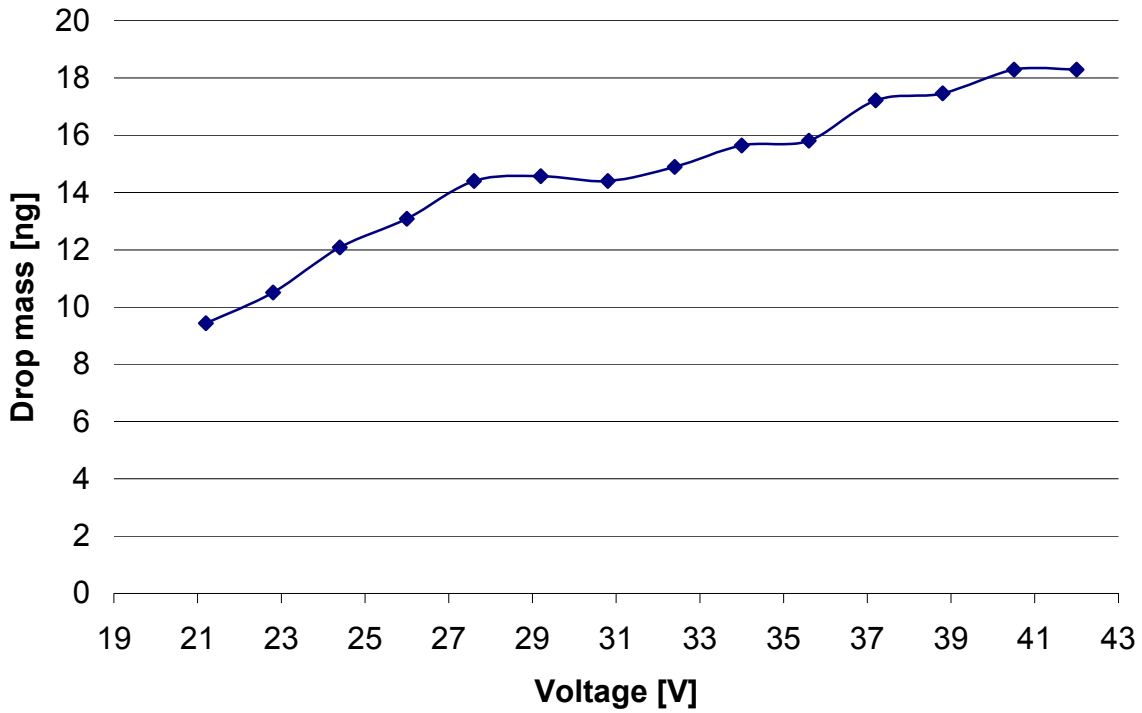
On the following picture you see a captured frame of a video taken during the testing of Dimatix Model Fluid. You can see that after the drop leaves the nozzle it has a tail. The liquid on this small scale is mostly influenced by cohesive forces within the fluid. Here not all of the tail collects into the main drop again. But you get a small drop of ink following the main drop. Switching to lower voltage leads to less tail. You could reduce the frequency, change the waveform, or a combination of these to get your desired drop formation. These drops were fired with 25V.

Dimatix Materials Printer User Manual

Nozzle

500µm

1000µm

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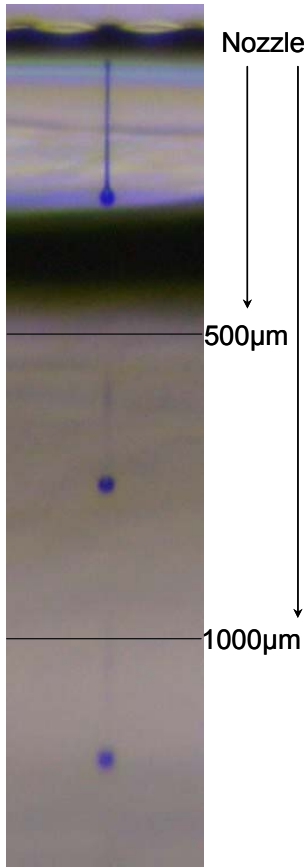
Cartridge

Note: When opening the sealed bag that the Fluid Module and Jetting Module come in take care to prevent particles from getting in the fluid ports.
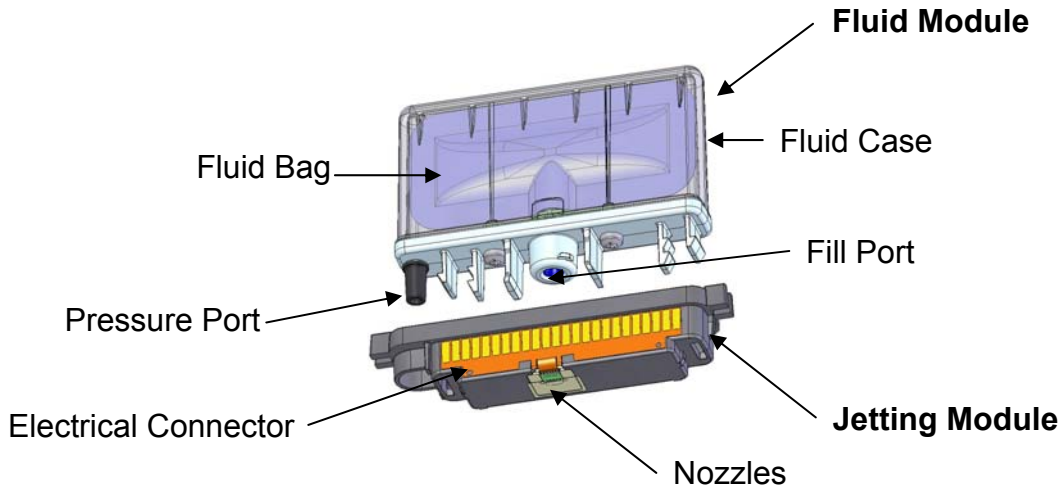
CAUTION

* Do not remove the film around the Nozzles. It will damage the cartridge.
** Do not fill the Pressure Port with fluid. It will damage the printer.
*** Do not get fluid on the Electrical Connector. It may cause electrical shorting.

Fluid Module Filling
Fill Syringe

• Pull fluid into syringe (1.5 mL)

• Install filter onto syringe. If the fluid is known to be filtered properly and not have agglomerates, you may not need to use a filter. Dimatix Model fluid does not a filter.
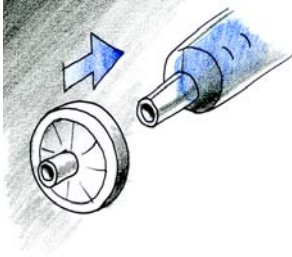
- Slip a fill needle on the filter of syringe
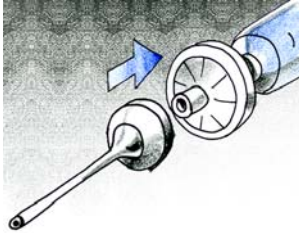
- Unscrew and remove the Fluid Module fill port cap
- Carefully insert the needle into Center Fill Port trying not to scrape the sides
- Slowly push the syringe plunger into fill the Fluid Module.

- Remove syringe
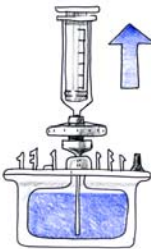
Assembly

Attach Fluid Module to Jetting Module

- Remove a Jetting Module from its sealed pouch.
- Align the Pressure Supply Port of the Fluid Module with the opening in the Jetting Module.

- Push the two halves straight together until the SECOND snap is felt and heard. This is a fairly rigid connection and takes a fair amount of force.

- Once the two pieces are snapped together the fluid can flow into the jetting device of the cartridge. * *Let the cartridge set for 30 minutes with the nozzles facing down.* At this point care must be taken to protect the nozzles of the cartridge. If the fluid is very low surface tension it may flow out of the nozzles. If it is highly volatile it may start drying at the nozzle leaving residue and thereby preventing it from jetting. It is best to immediately place the filled cartridge in the DMP.

Do not dispose this product as unsorted municipal waste. Collection of such waste separately for special treatment is necessary.
(Entsorgen sie dieses Produkt nicht als unsortierten Hausmüll. Eine Fachgerechte Entsorgung ist nötig.)

Cartridge Maintenance

The DMP contains hardware and software to perform one or more maintenance activities which are designed to initialize and maintain optimal jetting performance.

- The Cleaning Station contains an absorbent pad to draw ink off of the nozzle plate when it is brought close to it. It does not actually touch the nozzle surface but rather it contacts the face plate around the nozzle plate. The pad is replaceable.
- The Cleaning Station uses air pressure to pressurize the outside of the ink bag, which forces ink out through the nozzles. This is mainly used to initially prime the cartridge, but also as a method for reviving problem nozzles. The DMP includes a pump for this function, which is also used for meniscus control.

Specific functions include:

- **"Purging"** process pressurizes the cartridge to push fluid out the nozzles to remove trapped air to prime or clear the nozzles.

- **"Spitting"** is firing the nozzles at a selected frequency and duration. Tickle mode sends a non-firing pulse to the nozzles keeping the ink in motion at the nozzle plate to help keep it ready to fire.

- **"Blotting"** is when the cartridge lowers to the Cleaning Pad so that the pad can adsorb excess fluid from the nozzle plate.

- **Meniscus Control** is a low level vacuum applied to the ink reservoir to prevent ink from flowing out of the cartridge nozzles.

Cleaning Function Definitions

Maintenance Function	Definition	Benefits	Comments
Purging	Applies air pressure to outside of fluid bag to force fluid through entire fluid path and out all nozzles at once.	Required for initial use to force air out of fluid path (prime). Clear severely clogged nozzles. Can also be used to lower printhead temperature by purging hot fluid and bringing system temperature fluid into the flow path.	Produces high flow rate of fluid, so purge time should be minimized for 1 ml cartridges. Used as last resort for clearing clogged nozzles.
Spitting	Ejecting a predetermined number of drops at a predetermined frequency from one or more nozzles.	Clears the nozzles, brings fresh fluid to the pumping chamber and nozzles, keeps fluid path surfaces wet.	Consumes ink that cannot be used for printing. Typically used on a periodic basis, e.g. every X printing passes or every Y seconds, to maintain robust jetting performance.
Blotting	Bringing an absorbent and/or wicking medium in close proximity to nozzle plate (may lightly touch) to remove excess fluid from the nozzle plate. No wiping action.	Fluid puddling around nozzles can partially attach to ejected drops causing misdirected firing. In extreme cases, puddled fluid will flood the nozzle and prevent firing altogether. In addition, excess fluid on the nozzle can fall or be flung off onto substrate or printer components.	Risk of cross contamination when switching cartridges of diffeent fluid if the Cleaning Pad is not changed.
Tickle Mode	Exercising the pumping chamber at low amplitude to rhythmically pulsate the nozzle exit meniscus.	Retards "skinning over" of nozzle exit meniscus. Keeps nozzle exit wet.	May be sufficient to keep nozzles "alive" for lower volatility fluids as an alternative to spitting. Used while head is capped, or for low use nozzles during printing.

Failure Modes, Prevention and Recovery

	Failure Mode	Symptoms	Prevention	Recovery
1	Volatile solvents evaporate (dry) when printhead is not being used. fluid viscosity increases, fluid dries inside of nozzles, crusts on nozzle plate surface.	When printing starts again, nozzles won't fire, or fire poorly (low velocity, misdirected).	Cap printhead when not printing. Spit into cap to saturate air with solvent vapors. Spit occasionally and/or use tickle mode to keep nozzles alive.	Spit or purge, following by blot or wipe. Replace cartridge if severe.
2	Volatile solvents evaporate (fluid dries) in nozzles that are not being used. fluid viscosity increases, fluid dries inside of nozzles, crusts on nozzle plate surface.	When printing starts again, nozzles won't fire or fire poorly (low velocity, misdirected).	Exercise unused nozzles using tickle mode, and/or by spitting occasionally.	Spit or purge, following by blot or wipe. Replace cartridge if severe.
3	In newly filled cartridges there is air in the fluid path.	All nozzles fail to fire.	none	Purge the head to force air out of fluid path and fill pumping chamber and nozzles with fluid. Follow with blot or wipe to remove excess fluid from nozzle plate.
4	Air becomes ingested in the nozzle due to excessive drop ejection dynamics.	Some or all nozzles won't fire.	Adjust drive waveforms and/or fluid properties.	Purge the head to force air out of fluid path and fill pumping chamber and nozzles with fluid. Follow with blot to remove excess fluid from nozzle plate.
5	Fluid oozes out of the nozzles due to gravity and capilary action.	Fluid collects on the face plate (see next item below)	Increase meniscus control vacuum level.	Blot the nozzle plate.
6	Drops and/or puddles of fluid collect on the nozzle plate and hang down.	Excess fluid temporarily attaches to drops as they are being ejected causing misdirection and/or low velocity. Nozzles are flooded and will not eject drops at all. fluid falls onto substrate or printer, or is flung off by carriage motion.	Adjust drive waveforms to create more crisp drop ejection. Blot or wipe surface periodically during printing. Increase meniscus control vacuum level.	Blot the nozzle plate.
7	Pumping force is not enough to overcome meniscus control vacuum	Some or all nozzles won't fire.	Decrease meniscus control vacuum level.	Decrease meniscus control vacuum level.

System Faults

There are several error messages that may occur during operation of the DMP. In these cases you will usually get a message to power off the DMP and then power it back on. If the problem is not remedied by turning the DMP off (leave off for 5 seconds minimum) and then back on, the system will have to be returned to FUJIFILM Dimatix for service.

Faults

- "The cartridge drive amplifier has malfunctioned."

  This is an error in the Amplifier calibration. Try replacing the jet cartridge.

- "The platen heater is malfunctioning."

  This is a result of the platen heater having a short or an open.

- "A motor has malfunctioned"

  One of several motors has detected an error. Check for material blocking the platen or carriage movement.

- "Driver error"

- "Encoder index"

- "Home sensor"

- "Movement error"

- "The printer's 3 volt power supply has malfunctioned."

- "The printer's 5 volt power supply has malfunctioned."

- "The purge pressure is too low."

- "The cartridge meniscus vacuum can't be controlled."

- "The printer's internal memory has failed."

- "The printer CPU firmware upgrade has failed."

  In this case the system will ask you to "Try Again."

- "The printer FPGA upgrade has failed."

  In this case the system will ask you to "Try Again."

- "An undefined printer error has occurred."

Preventative Maintenance
Carriage

When installing cartridges, inspect the connector on the carriage holder. If you see any fluid on the connector, wipe it off with a clean lint free cloth or other similar material. Additionally, wipe any other fluid or debris from the holder area.

Inspect the pressure seal area on the cartridge holder also. Make sure it is free of debris to ensure that proper pressure regulation can occur.

Specifications

System Description

- o Flat substrate, xyz stage, "ink jet" deposition system
- o Low cost, user-fillable piezo-based ink jet print cartridges
- o Built-in drop jetting observation system
- o Variable jetting resolution and pattern creation PC-controlled with Graphical User Interface (GUI)
- o Capable of jetting a wide range of fluids
- o Heated vacuum platen
- o Cartridge cleaning station
- o Includes PC, monitor, and software

Mechanical System

- o Printable area
  - – Substrate size < 0.5 mm thickness: 210 mm x 315 mm (8.27 in x 12.4 in)
  - – Substrate size 0.5 - 25 mm thickness: 210 mm x 260 mm (8.27 in x 10.2 in)
- o Repeatability: ± 25 µm (± 0.001 in)
- o Substrate holder
  - – Vacuum platen
  - – Temperature adjustable ambient to 60° C
- o System footprint: 673 mm x 584 mm x 419 mm (26 in x 23 in x 16 in)
- o Weight approximately 43 kg (95 lbs)
- o Power 100-120 / 200-240 VAC 50/60Hz 375W maximum
  - – Fuse @ 250 V 2A SLO-BLO 5 x 20 mm
  - – Fuse @ 110 V 4A SLO-BLO 5 x 20 mm
- o Operating range 15-40° C at 5-80% RH non-condensing
- o Altitude up to 2000 m
- o Safety and EMC compliance
  - – Safety: NRTL Certified to EN 61010-1, UL 61010-1, CSA 22.2 No. 61010-1
  - – EMC: EN61326-1 Class A, FCC Part 15 Class A

Cartridge

- o Type: Piezo-driven jetting device with integrated reservoir and heater
- o Usable Ink Capacity: Up to 1.5 ml (user-fillable)
- o Materials Compatibility: Many water-based, solvent, acidic or basic fluids
- o Number of Nozzles: 16 nozzles, 254 µm spacing, single row
- o Drop Volume: 10 picoliter nominal

Control PC and GUI

- o Pre-loaded patterned templates
- o Pattern preview
- o Editors: Pattern, piezo-driven waveform, cleaning cycle, substrate setting

Replaceable Items

- o Print cartridge with one-time user-fillable reservoir
- o Cleaning station nozzle blotting pad
- o Drop watcher fluid absorbing pad

Options

- o Fiducial alignment camera plus theta platen
- o Gerber file import software

Warranty

System must be returned to FUJIFILM Dimatix for service in approved shipping container (original crate). Shipping will be paid by FUJIFILM Dimatix if during the warranty period. If system has been altered, modified or misused the warranty will be null and void.

Reference Information

Please visit the FUJIFILM Dimatix Web site at www.dimatix.com for the latest application and ink jet usage information in the deposition field.
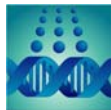
FUJIFILM Dimatix, Inc.
2230 Martin Avenue · Santa Clara, CA 95050 · USA
Technical Support Phone: (408) 565-7474
E-mail: mddsupport@dimatix.com · URL: www.dimatix.com
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