SG-1024/M-C Printhead

SG-1024/M-C Printhead
Product Manual

Dimatix FUJIFILM ™

1.0 About this Manual

Throughout this manual a variety of conventions are used to highlight essential information that is important for the overall safety and understanding of issues in using this product. These include:

1.1 Warnings

WARNING

Identifies information about practices or circumstances that can result in personal injury, damage to the product or economic loss.

1.2 Cautions

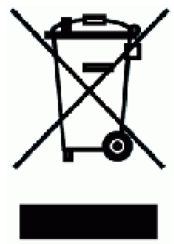
CAUTION

Identifies information about practices or circumstances that may lead to damage to the product.

1.3 ESD Advisory

Identifies where there may be a risk of Electro-Static Discharge (ESD).

1.4 Wheelie Bin Symbol



This symbol identifies parts that should be reclaimed as part of the Waste Electrical and Electronic Equipment (WEEE) Directive.

1.5 Important

IMPORTANT Identifies information that is essential to the understanding and correct use of this product.

1.6 Notes

Note: Used for emphasizing additional information that aids in the understanding and use of the product.

2.0 Safety Information

CAUTION

Hazardous voltages and temperatures are required for printhead performance. Therefore, it is essential that the printhead and its application environment provide for protection of the operator and service personnel, both via safe design and by warnings where necessary. Additional expanded labelling within the OEM equipment may also be desirable, since the functional information content of the labels on the product itself is limited by the space available on its surfaces.

3.0 Compliances

The SG-1024/M-C printheads are compliant with the Restriction of Hazardous Substances (RoHS) and Waste Electrical and Electronic Equipment (WEEE) directives as they pertain to electrical and electronic products.

SG-1024/M-C Printhead

The SG-1024/M-C Printhead

The SG-1024/M-C Printhead

1.0 Product Description

The SG-1024/M-C printhead is 400 dpi with a native drop ranging from 20 to 30 ng depending upon the fluid being jetted. The SG-1024/M-C printheads have four actuator assemblies with a single nozzle plate with eight rows of 128 nozzles.

Figure 1 - SG-1024/M-C printhead

These 1024 nozzle printheads are high performance, robust, and reliable drop-on-demand industrial printheads designed for single pass applications. Each has a dual ported ink interface to facilitate recirculation and is compatible with oil based ceramic jetting fluids. While the architecture of the printhead is compatible with many ink types, the tubing may not be. Before using this printhead with other inks, please make sure that you test compatibility. The SG-1024/M-C printhead is a down spitting printhead and features fluid interface and electrical connections at its top.

2.0 Related Documentation for SG-1024/M-C Printheads

The following list of documents relate to the SG-1024/M-C printheads. Many of these documents are referenced throughout this manual. All of these manuals are available from the Dimatix Tech Support web site. To create an account and access technical publications, go to www.dimatix.com and click on the Tech Support link at the bottom of the home page.

Application Notes:

AN000011 – *Ink Delivery System Design for Ink Jet Printers*

AN000026 – *Using Membrana Superphobic® Membrane Contactors*

AN000058 – *Binary Single Pulse and Binary Multi Pulse Waveform Development*

AN000062 – *Multi Pulse Waveform Development*

PM000069 – *SG-1024 Mercury Development Kit Product Manual*

3.0 SG-1024/M-C Printhead Product Labeling

There are two labels associated with the SG-1024/M-C printhead. They are:

- Printhead label
- Package label

3.1 SG-1024/M-C Printhead Product Label

The product label for the SG-1024/M-C printhead is etched into the nozzle plate. It has the serial number in both human readable and bar code scannable formats.

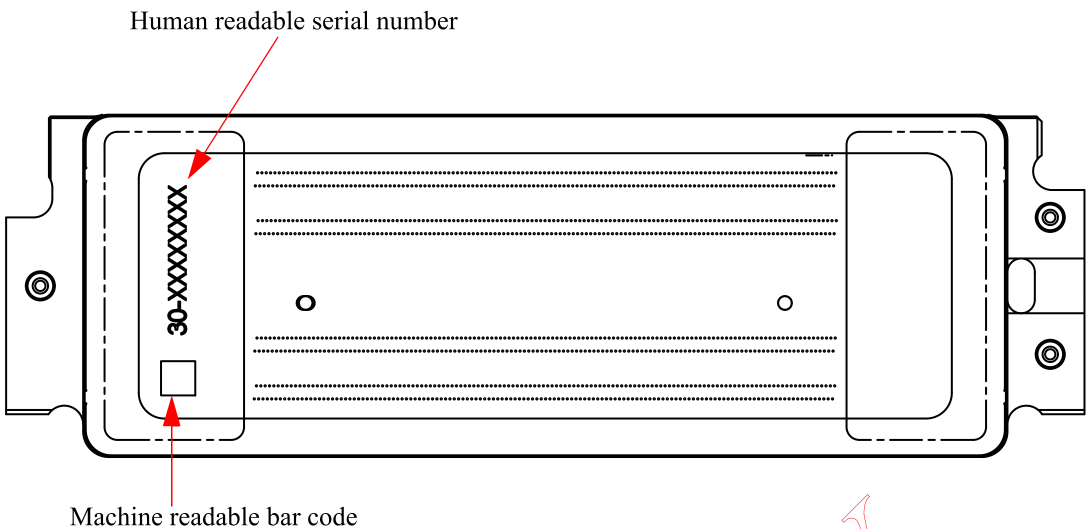


Figure 2 - Nozzle plate showing location of serial numbers

The serial number is prefixed with the native drop size and followed by the serial number of the printhead.

3.2 Package Product Label

The package product label (located on the printhead package) is different from the product label that is on the printhead. The part number on the package product label is the one to use when placing orders. The package product label contains additional information in both human and machine readable (bar code) formats. The following is a sample of the label.

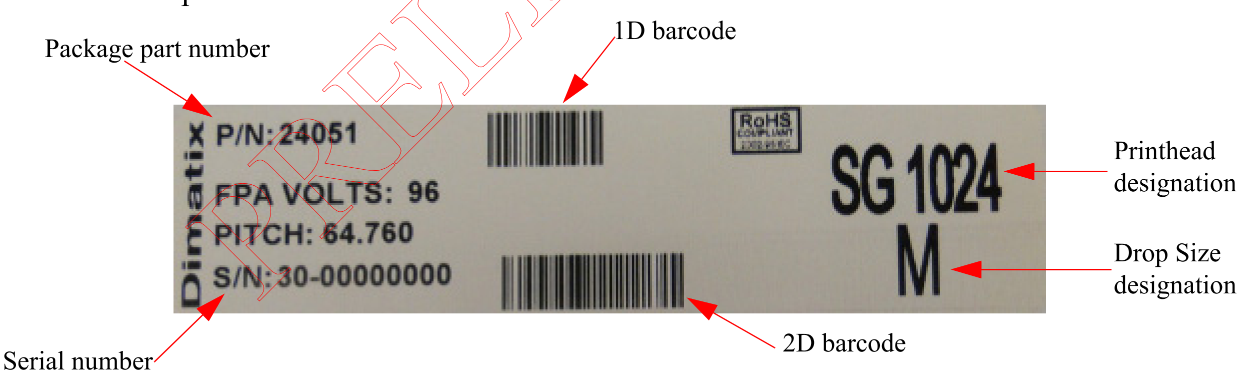


Figure 3 Sample of package product label for the SG-1024/M-C printhead

The following table shows the information contained on the package label.

Table 1 Package Label Contents

Information	Human Readable	Machine Readable (Bar Code)	
		2D (square)	1D (lines)
Unique EPROM Identifier		X	
Data Format Revision		X	
Packaged Part Number	X		
Tested Part Number		X	X
Serial Number	X	X	
FPA Voltage	X	X	
Pitch	X	X	

4.0 Operation

The SG-1024/M-C printheads are piezoelectric devices operating in shear mode. The jets are driven by a PZT array (Lead Zirconate Titanate), a piezoelectric ceramic. The shear mode of PZT actuation allows individual jets to be fired while simultaneously firing adjacent jets.

Prior to jet actuation, a serial data stream is clocked into the driver chips via the Head Interface Board (HIB), located inside the cover, to set up the desired jetting pattern for each fire pulse. The fire pulse voltage is applied to the selected PZT channels. The excitation of the PZT deflects the wall of the pumping chamber outward, creating a negative pressure wave that draws ink into the chamber. After a fixed pulse duration, the fire pulse voltage is removed. As the pumping chamber wall relaxes, the resultant positive pressure wave propagates forward and causes drop ejection at the nozzle.

The printhead has eight rows of 128 nozzles with a PZT for each row. A high-voltage fire pulse is applied, which actuates the PZT pumping chambers within each channel. All 1024 nozzles can be fired simultaneously or individually.

5.0 Interface Requirements

One of the primary benefits of the SG-1024/M-C printhead is its easy interface. It has one electrical interface, two fluid connections, and three screws for its mounting. The printhead has a thermistor built into the body and heating at the printhead is designed to be through the mounting plate. It can also support an optional internal heater and thermistor.

The primary interfaces that you need to be familiar with to make use of the SG-1024/ M-C printhead are mechanical, thermal, fluid, and electrical.

Table 1 SG-1024/M-C Printhead Interfaces

Interface	Description
Mechanical	Mounting to the printer, and alignment
Thermal	Thermal connections – thermistor, heater (optional)
Fluid	Jetting fluid connections and supply considerations
Electrical	Electrical connections to the printhead and HIB for fire pulse and data

Review the Interface Control Drawings for specific information regarding the SG-1024/M-C printhead interfaces.

Figure 4 - Interfaces for the SG-1024/M-C printhead

5.1 Handling and Installation

When handling the SG-1024/M-C printhead we recommend that you keep in mind the following advisory and warnings.

5.1.1 ESD Advisory

Electro-Static Discharge (ESD) safe handling techniques must be employed by anyone servicing or handling this product. At a minimum, wrist straps and static-safe packaging must be used. Where possible, other workstation ESD reduction measures should be employed as well.

5.1.2 Warnings

WARNING

The high drive voltage to the jets should be cut off by a safety interlock whenever an operator or service person is allowed access to the printhead.

Lock-out Tag-out procedures should be observed.

WARNING

The nozzle plate of the module is a fragile surface and should not be roughly handled or touched with sharp objects.

WARNING

Foreign materials should not be introduced into any ink fill port. This can result in damage to equipment or product loss.

6.0 Mechanical Interface

The SG-1024/M-C printhead can be mounted to the printer from either the top or the bottom. There are three mounting holes: two on the ink fill end of the printhead and one on the recirculation return (outlet) end of the printhead.

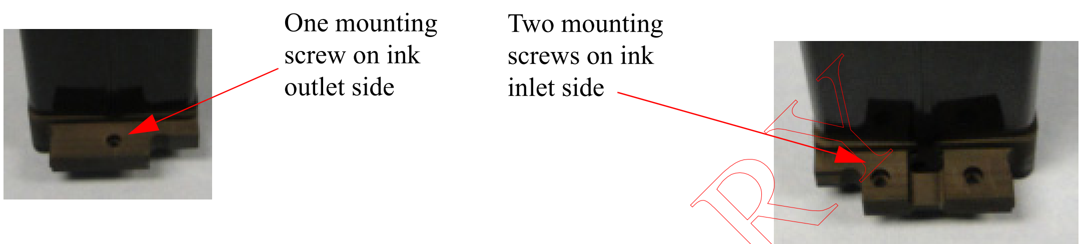


Figure 5 - Mechanical Interface

The screws are the same whether you mount the printhead from the top or from the bottom. The screws are M3 x 0.5 mm captive screws with 2.5 mm internal Hex drives. These screws are provided with the printhead.

When mounting from the top, the mounting screw should be bottomed in the receiving hole (4.5 mm deep). The receiving hole should be flat bottomed. The maximum torque value is 0.4 N-m. This sets the force applied by the spring holding the printhead in place.

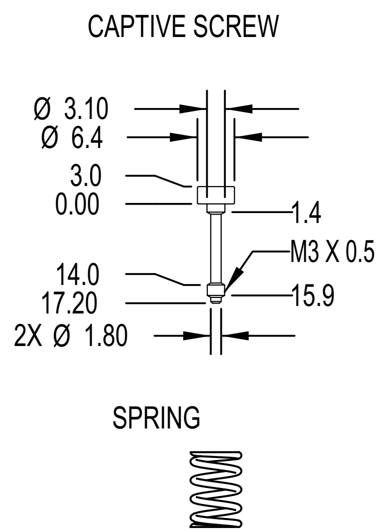


Figure 6 - Mounting screw cross-section

For bottom mounting an additional nut is required to hold the screw in place and to compress the spring.

6.1 Alignment Surfaces

The following figure shows the precision alignment surfaces.

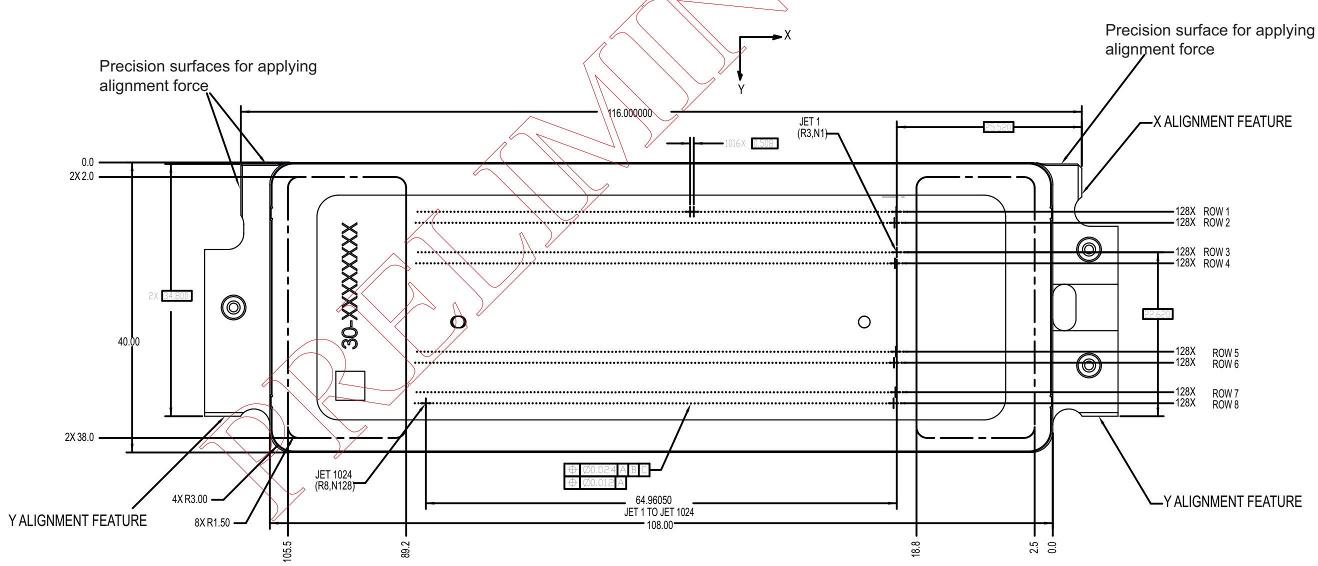


Figure 7 - Alignment surfaces locations

Please refer to the ICD in *Appendix A* for detailed information about the mounting surfaces and tolerances and the position of Jet1.

6.2 Recommended Mounting Forces Based on Reference Design

The following diagram and table provide the values for the registration forces, the clamping forces, and the friction coefficients. These values are the same for top and bottom mounting.

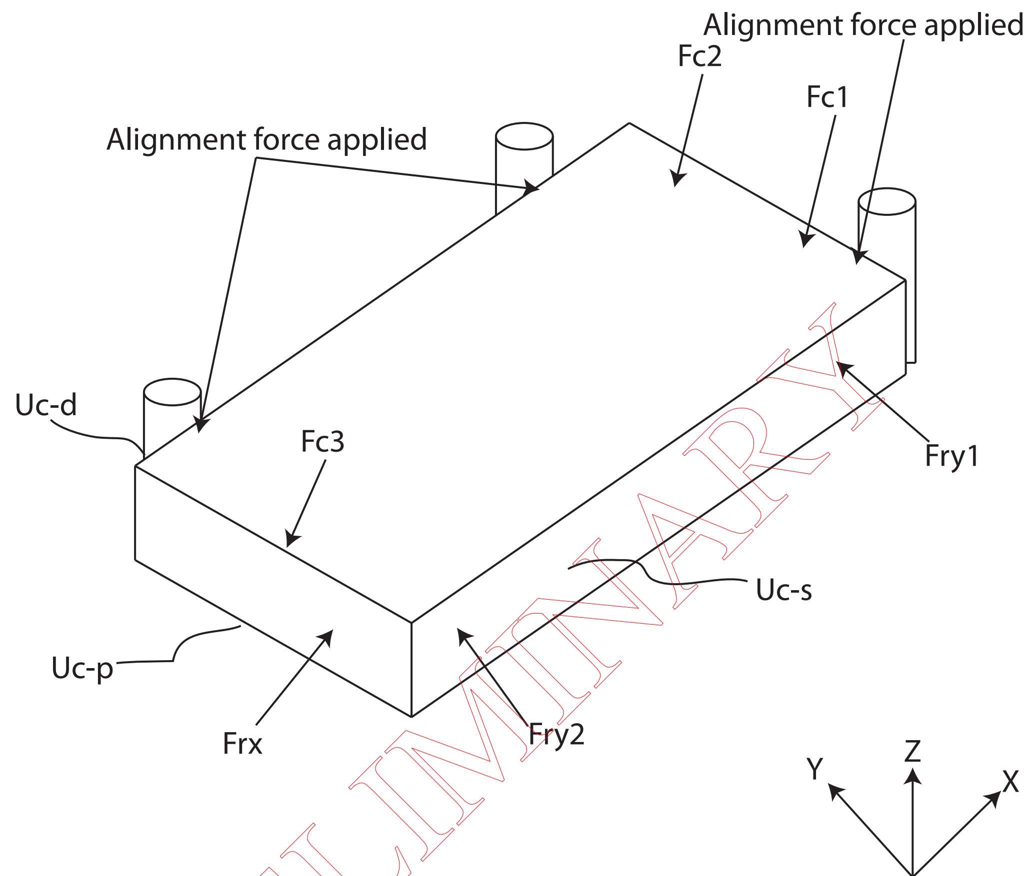


Figure 8 - Mounting forces

Table 2 Mounting Forces

Force Type	Nominal	Tolerance	Low Limit	High Limit
Registration Forces				
Frx	**64 N**	**10%**	**58 N**	**70 N**
Fry1	**32 N**	**10%**	**29 N**	**35 N**
Fry2	**32 N**	**10%**	**29 N**	**35 N**
Clamping Force				

Table 2 Mounting Forces

Force Type	Nominal	Tolerance	Low Limit	High Limit
Fc1	12 N	10%	11 N	13 N
Fc2	12 N	10%	11 N	13 N
Fc3	12 N	10%	11 N	13 N
Friction Coefficients				
Uc-p	0.25 N	12%	0.22 N	0.28 N
Uc-d	0.25 N	12%	0.22 N	0.28 N
Uc-s	0.25 N	12%	0.22 N	0.28 N

We strongly suggest that the surface of the carriage be finished with Nicklon as its properties make the friction coefficients easily reachable. For more information on Nicklon go to: www.balesmold.com/nicklon.htm.

6.3 Thermal Expansion

The thermal expansion values in the following table were measured in the free state due to the number of variables when trying to measure thermal expansion when mounted. The free state values are provided.

Table 3 Typical Thermal Expansion Values

Part	Thermal Expansion
Nozzle Pitch, (X)	7.1 PPM/°C
Nozzle Pitch, (row to row,Y)	11 PPM/°C
Jet1 to X registration Surface	7.8 PPM/°C
Measured Unconstrained	

6.4 External Heating

The SG-1024/M-C printhead is designed to be heated through the mounting plate. At each end of the printhead the flange provides 1.5 cm^2 of surface area for heat transfer. If the printhead is top mounted, then the area is at the bottom of the flange. If the printhead is bottom mounted, then the transfer area is at the top of the flange.

There is a thermistor built into the printhead for temperature monitoring through the 60 pin connector.

7.0 Internal Thermal Interface (Optional)

The SG-1024/M-C printhead does have a hole located under the mounting flange that can accommodate a heater for internal heating of the printhead. The heater hole is 3.23 mm x 84 mm deep.

The optional thermistor hole is 1.99 mm x 56 mm deep and is located above the mounting surface on the ink inlet end of the printhead. This optional thermistor is meant to work with external temperature control.

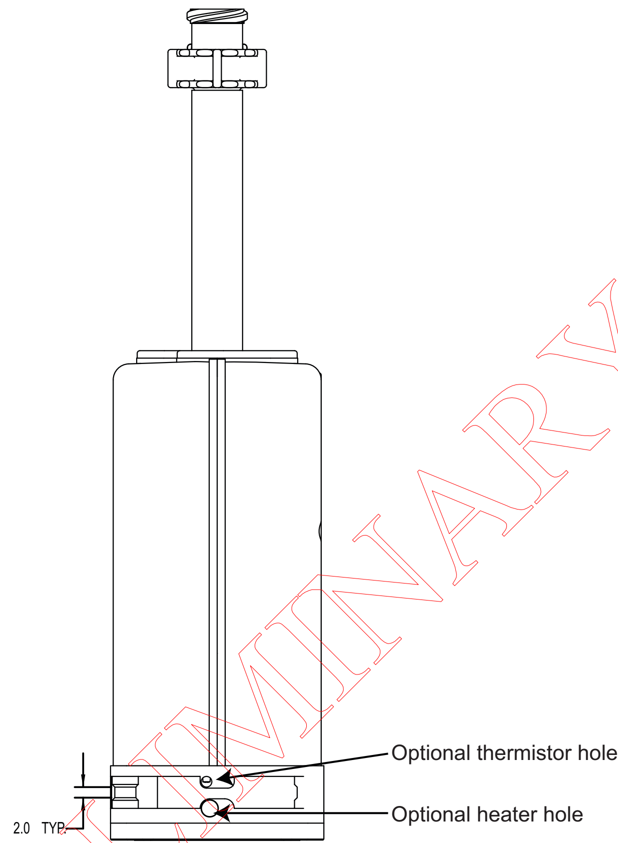


Figure 9 - Optional internal heater location

8.0 Fluid Interface

The fluid interface has one ink inlet connection and one ink outlet connection.

Refer to Interface Control Drawings in *Appendix A* for information regarding the fluid interface connections. The following parts of the printhead are in the fluid path

Table 4 Materials in Fluid Path

Material	Component
Resin filled carbon	Actuator body, manifold, and collar
Polyimide (Upilex)	Flink, rocktrap
17-7 Stainless Steel (Condition C)	Actuator and collar laminates
303 Stainless Steel	Collar barbs
Palladium-Nickel on Nickel	Nozzle Plate
Parylene	Actuator Assembly
Viton	Ink tubing
Spectra epoxy	Actuator and collar assemblies
E&C LA3032 Epoxy	Collar assembly
Nylon	Fluid connectors

See the ICD in Appendix A for additional parts that may come in contact with ink.

Figure 10 - SG-1024/M-C showing location of ink connections

8.1 Ink Inlet Connection

The ink inlet connection connects to the ink supply via a luer fitting. It extends beyond the printhead cover for easy access. The tubing is Viton and a mated luer fitting is included with the printhead.

8.2 Recirculation Return (Outlet) Connection

The recirculation return (outlet) connection connects to the Recirculation system. It extends beyond the printhead cover for easy access. The tubing is Viton and a mated luer fitting is included with the printhead.

8.3 Recirculation

Recirculation provides two main benefits to your print system. It allows for quicker priming times and it keeps the printhead wetted when handling quick drying inks. The following schematic is an example of a recirculation system.

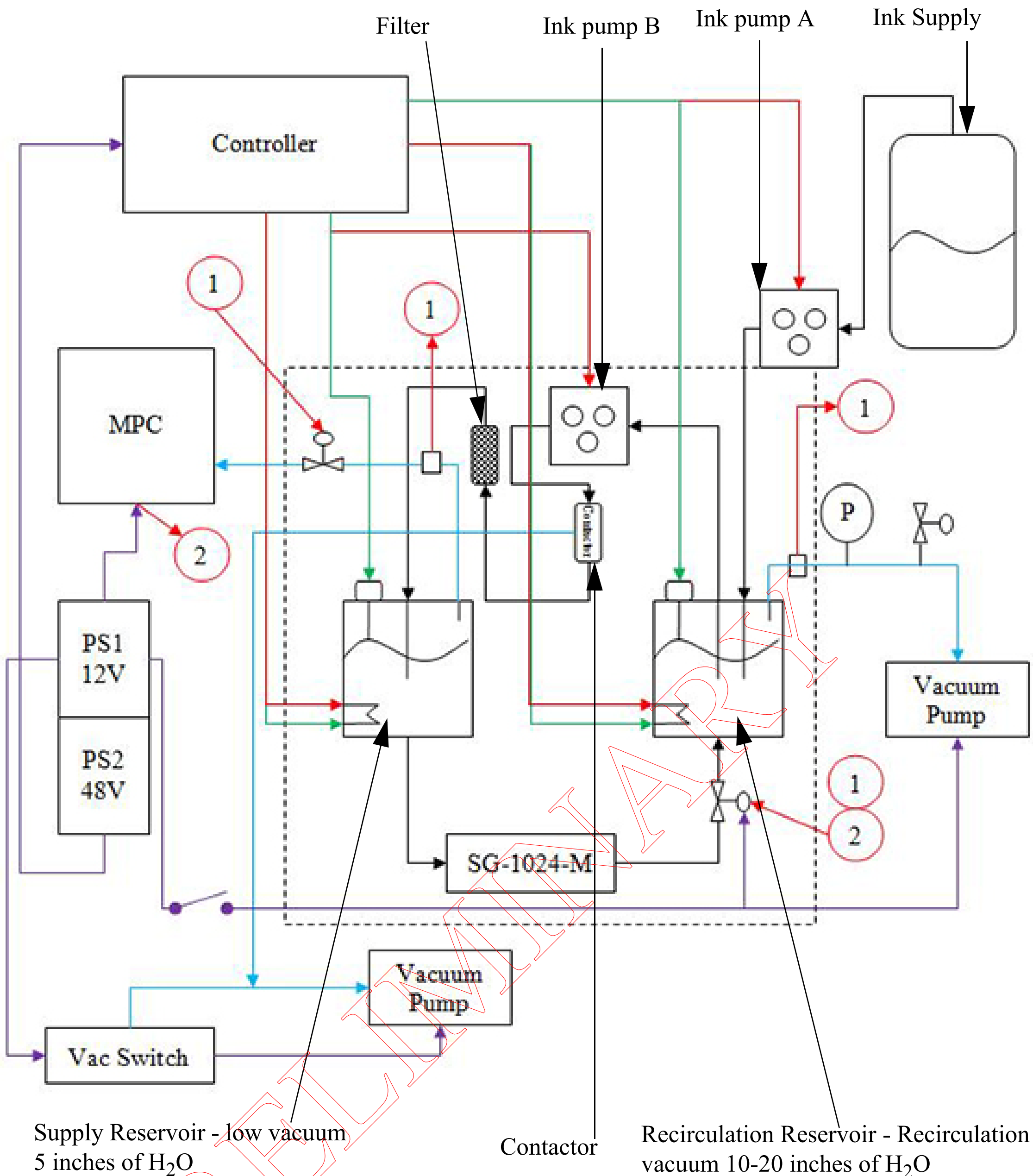


Figure 11 - Recirculation schematic of possible recirculation system

The above system works in the following manner:

1. Ink pump A draws ink from the ink supply and fills the recirculation reservoir.
2. Ink pump B pumps the ink from the recirculation reservoir.
3. The ink passes through the contactor to be degassed.

4. It then passes through the filter to remove any impurities.

5. The degassed and filtered ink fills the supply reservoir.

6. The supply reservoir fills the printhead.

7. The printhead prints then recirculates additional ink to the recirculation reservoir.

8. As the supply reservoir empties it signals the controller which causes it to refill from the recirculation reservoir and the system regains it equanimity.

For the purposes of our testing we have set the meniscus at head height plus one inch. The recirculation line was set to 50 mBar (20 inches of H_2O).

8.4 Fluid Supply

Establishing an efficient and functional fluid supply is crucial for good printhead performance. Long term compatibility with various jetting materials helps applications attain reliable results. The Fluid delivery system should be flushed prior to introducing any fluid to the printhead. If this is overlooked it can cause unnecessary problems. Refer to Application Note: *Flushing An Ink Delivery System*, document number AN000053, for an established procedure for flushing the ink delivery system.

8.4.1 Filtration

Although inks and jetting fluids must be well filtered during the manufacturing and packaging process, Dimatix strongly recommends that jetting fluids also be filtered just upstream of the printhead to the print system. Filtering at this location helps to trap any particles that may have been introduced when tubing was connected or when the printhead was installed. Such additional filtering is necessary because the quality of the jetting fluid is critical to product life and because there is no appreciable filter capacity within the printhead itself.

8.4.2 Deaeration

High frequency jetting sustainability and initial startup performance require using inks that are not saturated with dissolved air or other gases. Inks can be desaturated in a vacuum chamber and stored in airtight containers, or they can be actively degassed at the time of use in the printhead.

8.4.2.1 Contactors

Membrane contactors have proven to be highly effective in removing dissolved gasses and are easily implemented even within existing ink delivery systems. See Application

Note: *Using Membrana Superphobic® Membrane Contactors* (AN000026) for information about contactors and their implementation.

8.4.2.2 Meniscus Vacuum Regulation and Flow Rate

A small, negative pressure (referred to as the meniscus vacuum or meniscus pressure) should be applied at the local ink reservoir in order to establish the proper meniscus shape of the fluid in the nozzles and to prevent weeping of ink from the nozzles. The vacuum at each nozzle should be 6.5 mBar [2.5 inches H_2O]. The elevation difference between the reservoir free surface and the nozzles, multiplied by the ink's specific gravity, should be added to this in order to compensate for the weight of the fluid column.

Variations in the meniscus vacuum can result in image defects, particularly if the frequency of the fluctuation produces a spatial frequency within the range to which the human eye is most sensitive. A change in meniscus vacuum of 2.5 mBar [1 inches H_2O] can produce a measurable change in jet output. At 5-12 mBar [2-5 inches H_2O] excess vacuum, it is possible to cause jets to ingest air and stop firing. The recommended variation in the ink circulation vacuum is ± 127 mm of H_2O (± 5 inches of H_2O). Therefore, the flow design of the ink supply into the printhead should accommodate the worst case maximum jetting rate (drop mass x number of jets x print frequency x duty cycle), with a pressure drop less than about 1 inwg between the printhead and the free surface of the local ink reservoir.

8.4.2.3 Priming the Printhead

Prior to initial use of the SG-1024/M-C printhead, use the following steps to prime the printhead.

1. Load with ink.
2. Recirculation off.
3. Perform 2, 2 to 3 second purges at 275 mBar [4.0 psi] to ensure surfaces are wetted and air is out.
4. Recirculation running at -50 mBar (-20 inches of H_2O).
5. Perform 2, 2 to 3 second purges at 275 mBar [4.0 psi].
6. Wipe.
7. Print.

The SG-1024/M-C printhead does not require flushing prior to initial use if used with a jetting fluid compatible with the Prova model fluid shipped in the printhead.

9.0 Electrical Interface

The electrical interface is accomplished through a single 60 pin connector. All of the external electrical connections to the printhead are made through this connection. The connector is located on the top side of the Head Interface Board and extends through the cover for ease of connectivity. There is a rubber seal around the connector that minimizes the chance of fluid entering the cover.

Figure 12 - The SG-1024/M-C printhead HIB

The following sections include the electrical connections and their pinouts as well as information about the Head Interface Board (HIB).

9.1 SG-1024/M-C Head Interface Board

The Head Interface Board (HIB) is the main electrical interface for the printhead. The 60 pin interface located on the top side of the HIB contains all required power, ground, data, and control signal connections, as well as those for the fire pulse.

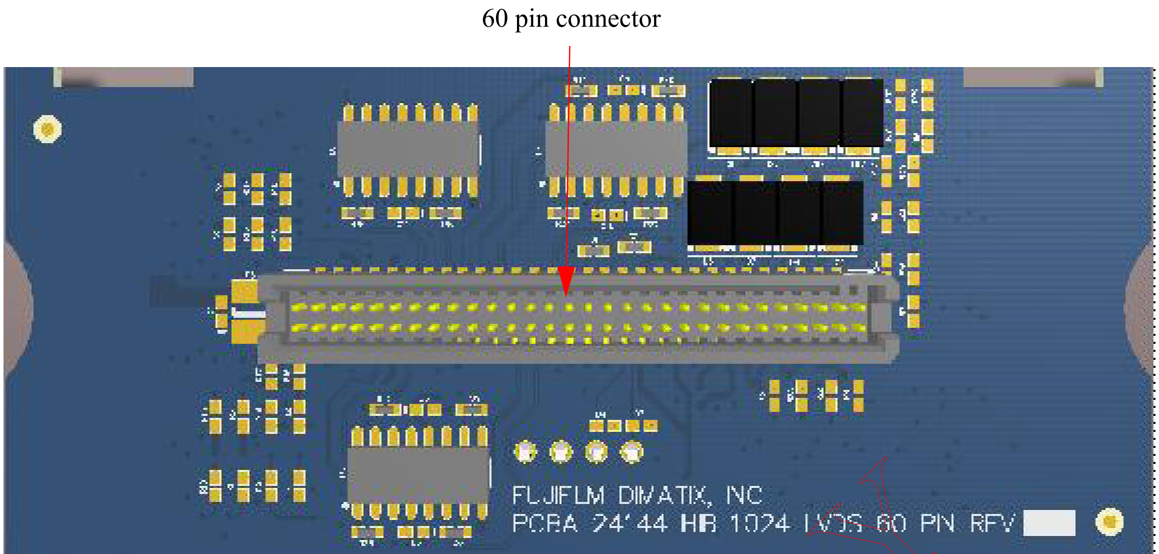


Figure 13 - Top of HIB

The eight 20 pin connectors on the underside of the HIB are for the eight flexes of the actuator assemblies. It also has a four pin connector for the heater and thermistor.

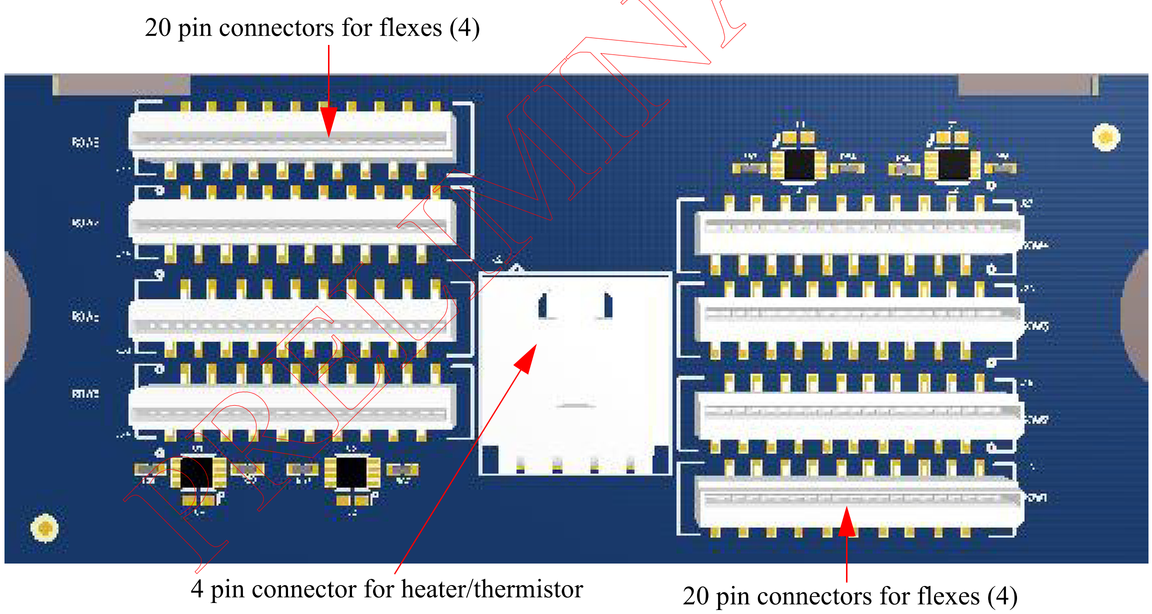


Figure 14 - Bottom of HIB

9.2 HIB Components

The top side of the board has the main input connector as well as the LVDS receivers and the ESD diodes. The bottom side of the board has 8 connectors for flex connections as well as a 4 pin connector for a thermistor and heater. The bottom side also has a collection of pull up and pull down resistors for address selection on the I^2C interface to each flex. For more information about LVDS, please visit the following National Semiconductor web site: http://www.national.com/assets/en/appnotes/National_LVDS_Owners_Manual_4th_Edition_2008.pdf. For information about the LVDS receiver got to http//www.ti.com/lit/ds/symlink/ds90c032b.pdf and for information about the mating LVDS driver go to http//www.ti.com/lit/ds/symlink/ds90c031b.pdf.

For more detailed information regarding I^2C go to: www.nxp.com/documents/user_manual/UM10204.pdf. For information about the SG-1024 flex's EEPROM data format and interface go to Appendix B to review the SG-1024 Flex EEPROM Data Format and Interface specification.

9.3 Input Connector (J1)

The HIB assembly has (1) 60 pin interface connector with 0.050 inch spacing. The connector is keyed with a recess that matches a protrusion on the cable connector to prevent misconnecting the cable to the HIB.

All of the external electrical connections to the SG-1024/M-C HIB are made through the J1 connector. It accepts the inputs for driving the SG-1024/M-C.

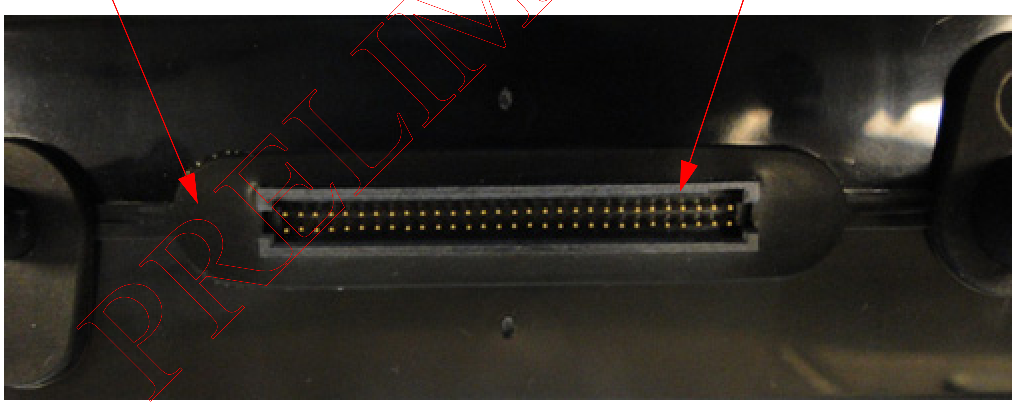


Figure 15 - J1 connector

The pinouts for the connector are listed in the following table.

Table 5 Connector Pin Assignments – Samtec TFM-130-32-L-D-A-K

Pin Number	Connection	Description
1	GND	Head Common
2	VCC	5.0 VDC Logic power for driver chips
3	GND	Head Common
4	VCC	5.0V DC Logic power for driver chips
5	GND	Head Common
6	GND	Head Common
7	CLK_N	Negative LVDS Data Clock Signal for driver chips – this clock fed into 4 clock buffers and distributed from there.
8	CLK_P	Positive LVDS Data Clock Signal for driver chips – this clock fed into 4 clock buffers and distributed from there.
9	GND	Head Common
10	GND	Head Common
11	LAT_N	Negative LVDS Data Latch Signal for driver chips – this control signal is shared by all (32) driver chips
12	LAT_P	Positive LVDS Data Latch Signal for driver chips – this control signal is shared by all (32) driver chips
13	D0_N	Negative LVDS Data signal serial input for Row 1-128 Nozzle HV outputs
14	D0_P	Positive LVDS Data signal serial input for Row 1-128 Nozzle HV outputs
15	D1_N	Negative LVDS Data signal serial input for Row 2-128 Nozzle HV outputs
16	D1_P	Positive LVDS Data signal serial input for Row 2-128 Nozzle HV outputs
17	D2_N	Negative LVDS Data signal serial input for Row 3-128 Nozzle HV outputs
18	D2_P	Positive LVDS Data signal serial input for Row 3-128 Nozzle HV outputs
19	D3_N	Negative LVDS Data signal serial input for Row 4-128 Nozzle HV outputs
20	D3_P	Positive LVDS Data signal serial input for Row 4-128 Nozzle HV outputs
21	D4_N	Negative LVDS Data signal serial input for Row5-128 Nozzle HV outputs
22	D4_P	Positive LVDS Data signal serial input for Row 5-128 Nozzle HV outputs
23	D5_N	Negative LVDS Data signal serial input for Row 6-128 Nozzle HV outputs
24	D5_P	Positive LVDS Data signal serial input for Row 6-128 Nozzle HV outputs
25	D6_N	Negative LVDS Data signal serial input for Row 7-128 Nozzle HV outputs
26	D6_P	Positive LVDS Data signal serial input for Row 7-128 Nozzle HV outputs
27	D7_N	Negative LVDS Data signal serial input for Row 8-128 Nozzle HV outputs
28	D7_P	Positive LVDS Data signal serial input for Row 8-128 Nozzle HV outputs
29	GND	Head Common
30	GND	Head Common
31	GND	Head Common

Table 5 Connector Pin Assignments – Samtec TFM-130-32-L-D-A-K

Pin Number	Connection	Description
32	SCL	I^2C Clock signal for Serial Interface
33	GND	Head Common
34	SDA	I^2C Data signal for Serial Interface
35	THB	Printhead Thermistor
36	THA	Pull Up for Printhead Thermistor
37	HTRB	Ground for Printhead heater
38	HTRA	Control for Printhead Heater
39	GND	Head Common
40	GND	Head Common
41	HTRB	Ground for Printhead heater
42	HTRA	Control for Printhead Heater
43	GND	Head Common
44	GND	Head Common
45	GND	Head Common
46	FP0	Fire Pule Tied to flex 0
47	GND	Head Common
48	FP1	Fire Pulse tied to flex 1
49	GND	Head Common
50	FP2	Fire Pulse tied to flex 2
51	GND	Head Common
52	FP3	Fire Pulse tied to flex 3
53	GND	Head Common
54	FP4	Fire Pulse tied to flex 4
55	GND	Head Common
56	FP5	Fire Pulse Tied to flex 5
57	GND	Head Common
58	FP6	Fire Pulse Tied to flex 6
59	GND	Head Common
60	FP7	Fire Pulse Tied to flex 7

GND – are the common grounds for the entire printhead including the Fire Pulse lines.

VCC – are the logic level power connections of (32) driver chips. Acceptable voltage levels at these pins are +4.5V DC to +5.5V DC. Each driver chip can require up to 25 mA of current from this connection for a total of 800 mA.

CLK_N/P – is the LVDS clock signal for clocking the serial data bits. The Clock signal is a logic level (5V nominal) signal and is distributed through buffers to all (8) of the driver chips. The maximum clock rate allowed is 16 MHz.

LAT_N/P – is a LVDS differential signal which controls the transfer (latching) of the data bit values in the driver chips from the driver input registers to the driver outputs. The Data Latch signal is shared by all (32) of the driver chips. The Data Latch occurs on the Logic Low → High edge transition on this input. When a logic "1" is transferred to a driver output, it will connect its respective ink jet cell circuit to the ground plane and enable that cell to "fire" when the high voltage fire pulse waveform is applied to the PZT array.

D0-7_N/P – are LVDS differential signals which provide serial input data stream for HV outputs 1 through 128.

SCL – is a logic level signal which provides the clock to an I^2C interface. This interface is serviced by an on board PIC.

SDA – is a logic level signal which provides the data to an I^2C interface. This interface is serviced by an on board PIC.

THB – are the ground sides of the thermistor which is central to the carbon body of the printhead.

THA – are the pull up side of the thermistor which is central to the carbon body of the printhead.

HTRB – are the ground side of a heating element which is central to the carbon body of the printhead.

HTRA – are the control side of a heating element which is central to the carbon body of the printhead.

FP1-7 – These pins are used to apply the high voltage fire pulse to all the jets on each of the flexes.

9.4 Ordering the Cable and Connector Assembly

To order the Samtec connector and cable to complete the electrical interface go to the Samtec web site at www.samtec.com. Use the following steps to order your connector and cable.

Figure 16 - Samtec Home page

1. At their home page, type SFSD in the Search field and click on GO.

2. This action takes you to the Search Results screen.

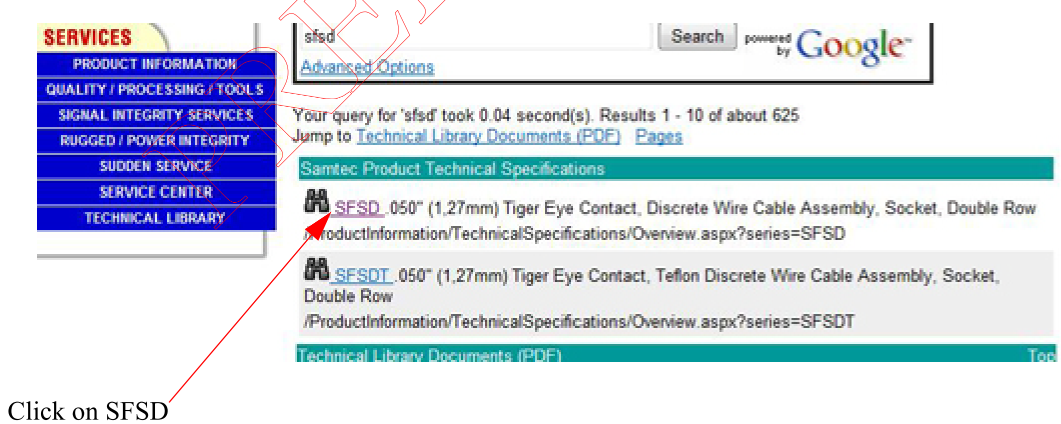


Figure 17 - Search Results screen

3. Click on SFSD to access the SFSD Series Overview.

Select Build a DW Cable Assembly

Figure 18 - SFSD Series Overview screen

4. At the SFSD Series Overview screen, click on Build a DW Cable Assembly. This action takes you to the Samtec Discrete Cable Builder screen.

Figure 19 - Discrete Wire Cable Builder screen

5. At the Samtec Discrete Cable Builder screen, you begin to select the properties for the cable assembly.

6. Under the Positions per Row category choose **30**.

7. Under the Wire Gauge category choose **28**.

8. Under Plating Options, select **G 10 u Light Gold on Contact, 3 u Gold on Tail**.

9. After filling in the above fields click on **Continue** to proceed to the cable length option.

Fill in the Length of Assembly field

Figure 20 - Cable Length selection screen

10. Enter the desired cable length in either mm or inches. We recommend that the cable be 1 meter or less.

11. Click **Continue** to go to the End 1 and End 2 option screen.

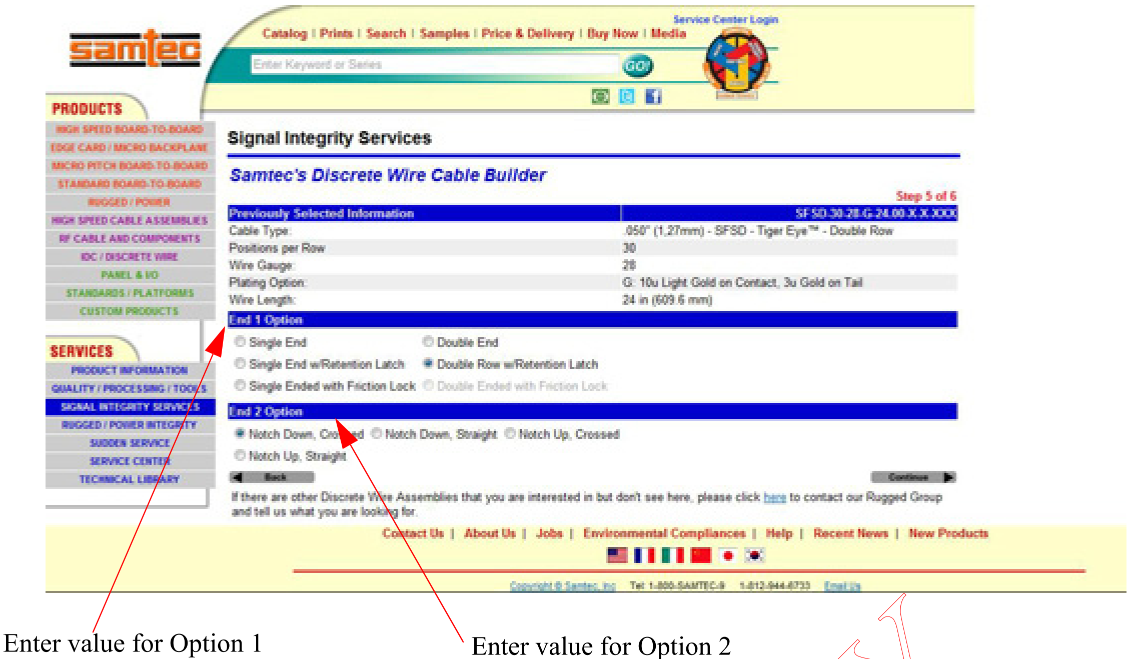


Figure 21 - End 1 and End 2 Option screen

12. Select **Double Row w/Retention Latch** for End 1 Option. After making your selection the End 2 Option field displays.

13. Select **Notched Down, Crossed** for End 2 Option.

14. Click on **Continue** to move to the next screen.

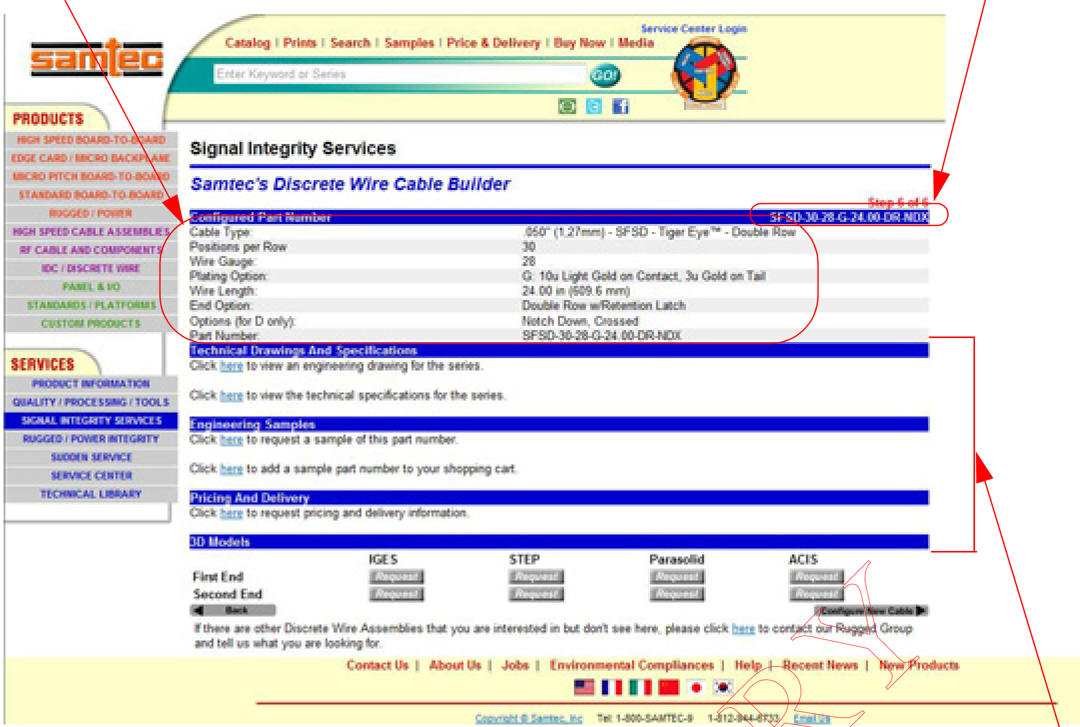


Figure 22 - Order review screen

The preceding screen contains the configured part number and a review of the cable assembly properties that you selected. Review these to ensure that the assembly is configured properly for your needs.

This screen also contains several options. How you proceed is determined by what you select. Your options are:

- **Technical Drawings and Specifications** – allows you to view the drawings or specifications for this series.
- **Engineering Samples** – options for requesting a sample of the part number and for adding a sample part number to your cart.
- **Pricing and Delivery** – this is where you request pricing and delivery information.
- **3D Models** – this is where you can request a 3D model of the part. The 3D models are available ina variety of formats.

9.5 Grounding

CAUTION

For the safety of the equipment operators and of the equipment, and for compliance with IEC safety standards, any printhead must be earth grounded at all times during operation of the equipment. Any OEM product cover should include recognized safety labelling for electrical shock hazard. The cover should be electrically resistive and prevent operator contact with any electrical hazard on the printhead.

The printhead is grounded through its contact with the carriage. Please refer to the ICD in Appendix A for more information.

9.5.1 ESD Drain

The ESD drain is accomplished through its contact with the carriage.

10.0 Operating Modes and Timing Requirements

The printhead can operate at a wide range of data and jetting frequencies, and supports four (4) modes of operation.

CAUTION

Under no circumstances should the driver chip outputs be made to change state while a fire pulse is active or damage to the HIB or PZT array may occur.

10.1 Serial Data Timing

Each PZT flex assembly has 1 serial data input line. To completely load all (128) driver chip outputs with new image data, a series of one hundred and twenty eight (128) Clock pulses must be used in coordination with appropriate data bit values on this data line (4 x 32 bits = 128 output bit values). One serial data line is daisy chained through all four driver chips on the flex.

Data sequencing should be performed according to the following table.

Table 6 Jet Mapping Data

Row	Jets	Connector Pin	Pixel Numbers (Column)
1	2, 10, 18, 26, ..., 1018	13, 14	1022, 1014, 1006, ..., 6
2	6, 14, 22, 30, ..., 1022	15, 16	1018, 1010, 1002, ..., 2
3	1, 9, 17, 25, ..., 1017	17, 18	1023, 1015, 1007, ..., 7
4	5, 13, 21, 29, ..., 1021	19, 20	1019, 1011, 1003, ..., 3
5	3, 11, 19, 27, ..., 1019	21, 22	1021, 1013, 1005, ..., 5
6	7, 15, 23, 31, ..., 1023	23, 24	1017, 1009, 1001, ..., 1
7	4, 12, 20, 28, ..., 1020	25, 26	1020, 1012, 1004, ..., 4
8	8, 16, 24, 32, ..., 1024	27, 28	1016, 1008, 1000, ..., 0

This sequence loads data into all 32 driver chips. Data transfer to the driver chip outputs follows one of two modes: Transparent Latch Mode or Latched Data Mode. To use Transparent Latch Mode, hold the Data Latch input at V_{IH} level (1) while clocking in serial data. During data clocking the output states of the driver chips change after each new data bit shifts in. To use Latched Data Mode, hold the Data Latch input at V_{IL} level (“0”), clock in all data, then raise the Data Latch signal. Driver chip outputs remain in their previous state until Data Latch is raised, permitting data transmission during periods of high fire pulses. These operating modes and their respective timing diagrams are described in further detail in the following sections.

WARNING

Changing the output state of the driver chips during an active fire pulse can destroy the driver chips and/or associated circuitry on the jetting assembly.

To avoid possible timing violations which could damage data or jetting controller circuitry, maintain a 1 µs (microsecond) gap between the start or end of a fire pulse and the changing of the output data of the jetting assembly. This 1 µs gap is shown in the following figure as timing interval **T2**.

Figure 16 shows a simplified single pulse fire pulse waveform and the timing windows (green) during which it is safe for the driver outputs to change state. The time interval needed to load the driver chips with data (**T1**) is 32 data bits/16 MHz = 2 µs. The maximum fire pulse rate is **T1** + 2 x **T2** + **T3** = **T4**. The timing can be relaxed if the print rate allows (i.e. clock can be less than 16 MHz).

The following are examples of clock/print rates.

Parameters:
Print Rate: 62.5 kHz
Grey levels: 4
Bits to Encode Grey Level: 2

Number of nozzles	Fire Pulse Frequency (kHz)	Fire Pulse Period (µs)	Fire pulse Period Minus T2 Safety Margin	Required Minimum Clock Frequency (MHz)	Comments
128	125	8	6	21.333	This is the MAX clock rate for the printhead but is not suitable for printing.

Parameters:
Print Rate: 16 kHz
Grey levels: 4
Bits to Encode Grey Level: 2

Number of nozzles	Fire Pulse Frequency (kHz)	Fire Pulse Period (µs)	Fire pulse Period Minus T2 Safety Margin	Required Minimum Clock Frequency (MHz)	Comments
128	32	31.25	29.25	4.376	This is the MAX print rate for grey scale printing.

Parameters:
Print Rate: 30 kHz
Grey levels: 2
Bits to Encode Grey Level: 1

Number of nozzles	Fire Pulse Frequency (kHz)	Fire Pulse Period (µs)	Fire pulse Period Minus T2 Safety Margin	Required Minimum Clock Frequency (MHz)	Comments
128	30	33.333	31.333	4.085	This is the MAX print rate for binary printing.

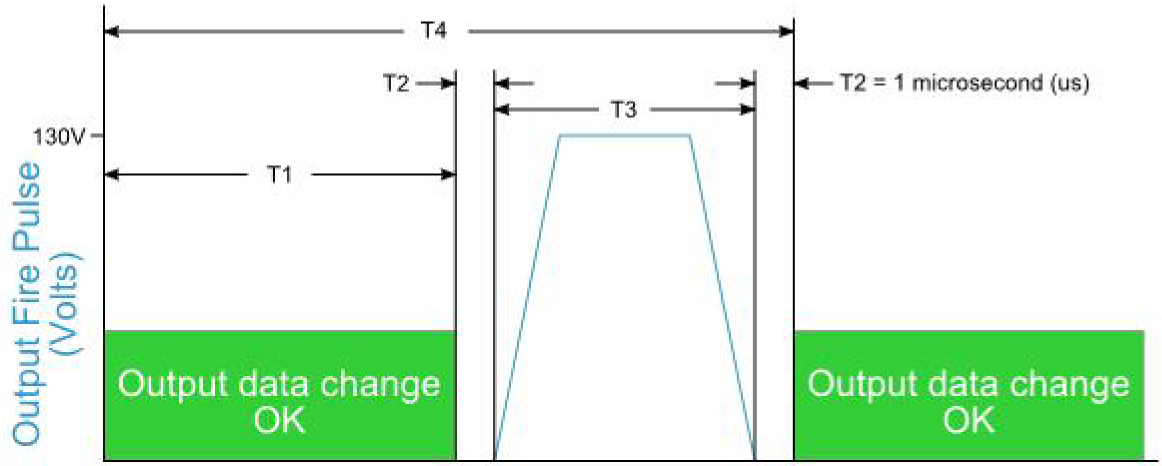


Figure 23 - HIB Driver Output Timing

Supported HIB operation modes and their timing requirements are described in the following sections.

10.2 Transparent Latch Mode

This is the simplest normal operational mode of the SG-1024/M-C because the Data Latch input is held at a constant logic level 1 (> 4.0VDC). In this mode, data bits are transferred directly from the 32-bit input shift registers of each driver chip to the outputs during serial data loading. While this has the advantage of simplicity, it has the disadvantage of driver outputs changing state during the clocking of the serial data.

It is critical that no serial data clocking or clock line activity on the Clock input occurs while a fire pulse waveform is being applied to the driver chip, or driver chip damage may result.

As a safety margin, users should provide a one microsecond (1 µsec) time window starting immediately before and extending until one microsecond (1 µsec) after a fire pulse waveform during which no clock pulses occur. Clocking of serial data into the SG-1024/M-C may occur at any time that does not conflict with this time window.

Transparent Latch Mode may present undesirable limitations depending upon the jetting frequency demands of the system. In this situation, the Latched Data Mode of operation can be used. On this assembly polarity and blank are not brought out to the connector but they are pulled to a logic level HIGH using pull up resistors. If Latch is left high this mode is enabled. If latch is driven low, the device will be in transparent latch mode.

Table 7 Transparent Latch Mode Function

Datax	Clock	Data Latch	Blank	Polarity	Driver Output
0	↓	1	1	1	0
1	↓	1	1	1	1

X = Don't Care (not applicable)

1 = Logic Level "1" (Vin > 4.0V)

0 = Logix Level "0" (Vin < 1.0V)

↓ = Falling Edge signal

Timing diagrams of the Transparent Latch Mode of operation follow.

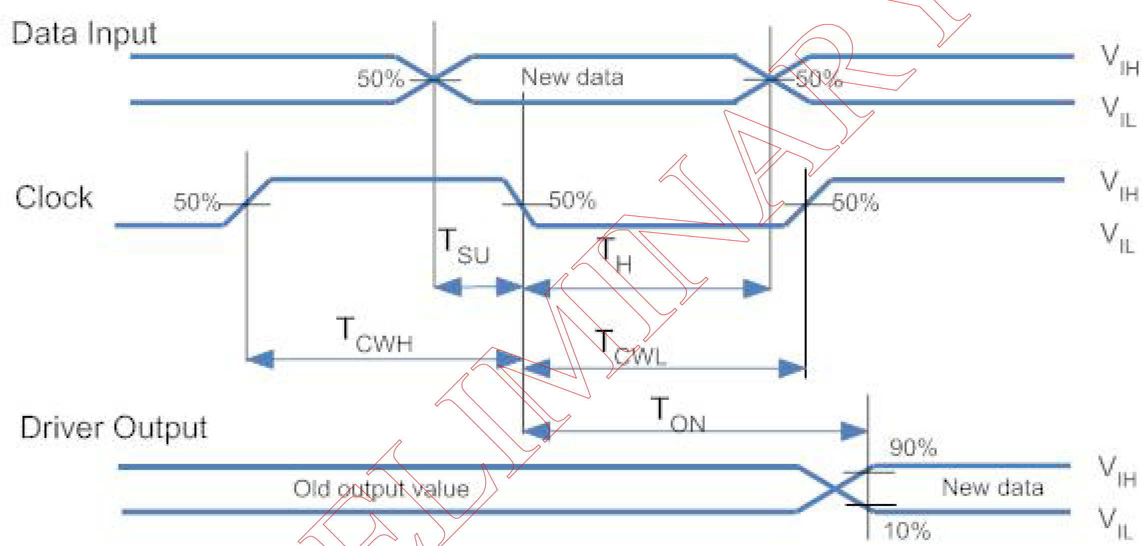


Figure 24 - Transparent Latch Mode Timing Diagram

Table 8 Transparent Latch Mode Timing(VCHIP = 5.0V, T_{AMB} = 25C)

Symbol	Parameter	Min	Typ	Max	Units
T_{CWH}	Clock High pulse width	-	31.25	-	ns
T_{CWL}	Clock Low pulse width	-	31.25	-	ns
T_H	Data Hold Time after ↓clock edge	10	-	-	ns
T_{SU}	Data Setup Time before ↓clock edge	25	-	-	ns
T_{ON}	Turn on time for driver output	-	-	400	ns
F_{CLK}	Clock Frequency	-	-	16	MHz
C_{INDatx}	Data Input pin capacitance	-	-	30	pF
C_{INCL}	Control/Clock Input pin capacitance	-	-	200	pF

10.3 Latched Data Mode

On this assembly polarity and blank are not brought out to the connector but they are pulled to a logic level HIGH using pull up resistors. Latched Data Mode provides maximum timing flexibility because serial data may be clocked into the SG-1024/M-C during the fire pulse. Driver chip outputs do not change state until the Data Latch input transitions from logic “0” to logic “1”.

Data bits may be safely clocked into the driver chips at any time provided Data Latch remains LOW; the driver outputs are isolated from the input shift register by the internal latches. This provides the flexibility of clocking the data into the SG-1024/M-C at almost any time, as long as the Data Latch signal is held at logic level “0” and only allowed to transition to logic level “1” during a “safe” window of time in which no fire pulse waveform is active on the SG-1024/M-C.

WARNING It is critical that no latching of data to the driver outputs occurs while a fire pulse waveform is being applied to the driver chip, or driver chip damage may result.

As a safety margin, users should provide a one microsecond (1 usec) time window starting immediately before and extending until one microsecond (1 usec) after a fire pulse waveform during which no clock pulses occur. Latching of serial data into the SG-1024/M-C may occur at any time that does not conflict with this time window.

Latched Data Mode can provide greater total throughput than Transparent Latch Mode.

Table 9 Latched Data Mode Function

Datax	Clock	Data Latch	Blank	Polarity	Driver Output
0	1 or 0	↑	1	1	0
1	1 or 0	↑	1	1	1

X = Don't Care (not applicable)

1 = Logic Level "1" (Vin > 4.0V)

0 = Logix Level "0" (Vin < 1.0V)

↑ = Rising Edge signal

Timing diagrams of the Latched Data Mode of operation are shown here.

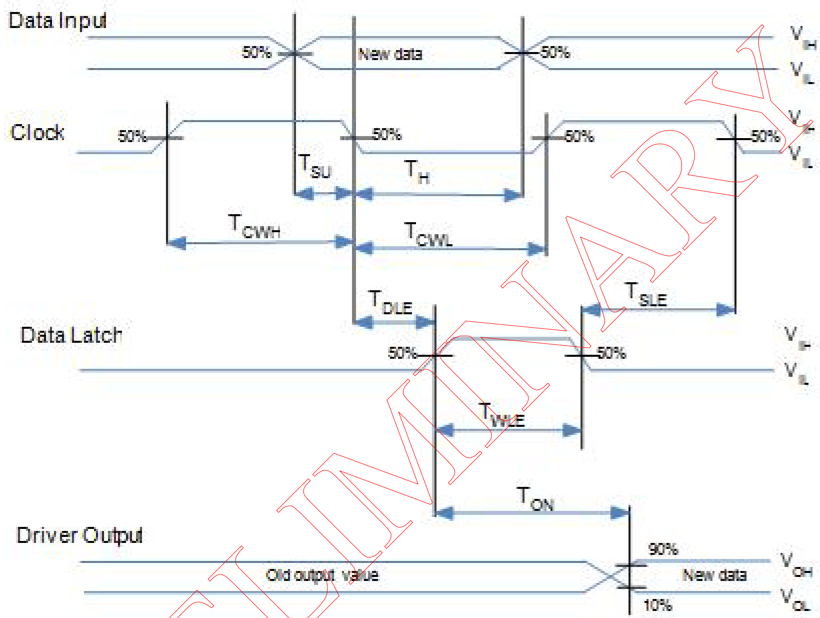


Figure 25 - Latched mode timing diagram

Table 10 Latched Data Mode Timing (VCHIP = 5.0V, T_{AMB} = 25° C)

Symbol	Parameter	Min	Typ	Max	Units
T_{CWH}	Clock High pulse width	-	31.25	-	ns
T_{CWL}	Clock Low pulse width	-	31.25	-	ns
T_H	Data Hold Time after ↓clock edge	10	-	-	ns
T_{SU}	Data Setup Time before ↓clock edge	25	-	-	ns

Table 10 Latched Data Mode Timing (VCHIP = 5.0V, T_{AMB} = 25° C)

Symbol	Parameter	Min	Typ	Max	Units
T_{DLE}	Delay Time from ↓clock edge to ↑Data Latch edge	20	-	-	ns
T_{WLE}	Width of Data Latch pulse	20	-	-	ns
T_{SLE}	Data Latch Setup Time before ↓clock edge	20	-	-	ns
T_{ON}	Turn on/off time for driver output	-	-	400	ns
F_{CLK}	Clock Frequency	-	-	16	MHz
C_{INDatx}	Data Input pin capacitance	-	-	30	pF
C_{INCL}	Control/Clock Input pin capacitance	-	-	200	pF

11.0 Technical Specifications of the HIB

This section provides environmental and recommended operating parameters for the HIB. For proper operation of the HIB, it is recommended that storage and operation only occur under the following conditions.

11.1 Operating Voltages and Conditions

The HIB is designed to be operated with the following recommended voltage levels and frequency limits.

Table 11 Operating Voltages and Conditions

Symbol	Parameter	Min	Typ	Max	Units
VCHIP	Logic Supply Voltage	4.5	5.0	5.5	V
V_{IL}	Data/Control Input Low Level Voltage	0	-	0.2*VCHIP	V
V_{IH}	Data/Control Input High Level Voltage	0.8*VCHIP	-	VCHIP	V
Fire Pulse	Fire Pulse Voltage	-0.5	-	130	V
Slew Rate	Fire Pulse Voltage slew rate	-	-	45	V/us
Clock Frequency	Serial Data Clock frequency	-	-	16	MHz

12.0 Product Characteristics

12.1 Nozzle Pitch and Registration

The nozzle pitch (nozzle-to-nozzle distance) establishes the native dpi of the printhead. Nozzle pitch increases slightly with increased temperature. The printhead has a nozzle pitch of 0.0635 mm [0.0025 inches]. The printhead is not designed for using saber angle.

12.2 Drop Mass

For imaging applications, adequate drop mass is essential in order to achieve solid area fill and to mask drop placement errors. Jet to jet drop mass uniformity should be considered when developing the image model. Average drop mass may vary with respect to jetting frequency.

12.3 Jet Straightness

Drop trajectory errors are the angular deviation from the ideal (perpendicular to the nozzle plate). Process direction straightness, in conjunction with drop velocity uniformity, determines edge raggedness, but in most cases this is not as critical as cross-process jet straightness.

Reducing the standoff distance between the nozzles and the substrate as much as possible minimizes jet-straightness drop placement errors.

12.4 Drop Velocity

For imaging applications, adequate drop velocity and velocity uniformity are essential for accurate drop placement in the process direction. For a given velocity variability, drop placement errors are directly proportional to the process velocity and standoff distance, and inversely proportional to the drop velocity. Drop velocity varies with frequency and is affected by both fire pulse amplitude and fire pulse width.

Although the drop mass and velocity have different frequency response curves, their mean values track closely at a given frequency with respect to pulse amplitude and, within a limited range, pulse width parametric changes. Jet-to-jet variability can be assumed to correlate as well.

Reducing the standoff distance between the nozzles and the substrate as much as possible minimizes velocity related placement errors.

12.5 Crosstalk

Another contributor to jet-to-jet variability is crosstalk, or the affect on the drop mass/velocity of one channel from the simultaneous operation of neighboring jets. Crosstalk effects can be either negative (decreasing the drop mass/velocity) or positive (increasing the drop mass/velocity). The specified maximum crosstalk value is the combined effect from all causes: electrical, fluidic, and mechanical. It is measured as the velocity variation between one jet vs. all jets firing.

12.6 Operating Temperature Range

The lower end of the operating temperature range is essentially a “cold” normal room temperature. There is no reason why the printhead cannot function at a colder temperature, assuming that condensation is avoided. Most users jet at temperatures slightly above normal room temperature because it allows easy control of temperature and thus viscosity, benefiting output uniformity. The upper temperature operating limit is determined by the potential weakening of internal bond integrity, both from time at temperature and from thermal cycling. Thermal cycling outside the specified temperature range can also cause a gradual decrease in jet performance due to a pyroelectric effect on PZT poling coefficients.

12.7 Sustainability

Sustainability is defined as the ability of all jet channels to sustain proper firing within the performance requirements of an application during normal operating conditions. Since sustainability is so strongly influenced by ink properties, the printing profile, and environmental conditions, an absolute specification value is arbitrary at best. However, Dimatix performs sustainability tests with a model fluid under lab conditions, and these tests are a demonstrable measure of design robustness. Jetting sustainability can be enhanced by incorporating active deaeration of the jetting fluid, keeping the orifice plate clean from contamination, and selecting an operating point (e.g., Fire Frequency and Voltage) well within the printhead performance envelope. Fortunately, if the sustainable performance limit has been exceeded and jets begin to fire poorly or not at all, full operation can be easily restored, usually by simply returning to set points within the performance window.

12.8 Life

The primary determinants of life are the quality of the jetting fluid (filtration, chemical and thermal stability, and pigment suspension) and the operating environment (external contamination, physical damage to the printhead, and proper maintenance). Like sustainability, life is strongly influenced by the specific application of the product, making an absolute life or MTBF specification relatively meaningless.

A series of tests are performed to demonstrate the inherent longevity of a design. Printheads are characterized at the start of these longevity tests, then characterized again after tens of billions of jet actuations, to ensure that no significant impact on performance has occurred as a result of the stress tests. It is important to make the distinction that these tests do not predict the life of the product; rather they demonstrate confidence that the design is competent for long life service under controlled conditions. Each application implementation bears the responsibility for ensuring that a commercially acceptable life can be achieved.

13.0 Recommended Operating Conditions

13.1 Coupon

SG-1024/M-C printheads are shipped with a test coupon. The coupon shows a print sample and the test values for the printhead. In order to enable customers to optimize the uniformity of performance from our printheads, we calibrate each unit as part of the final test procedure.

Figure 26 - SG-1024/M-C FAT coupon

The coupon or report contains the following information:

Serial Number

Date of Testing

Calibrated Voltage

Head Average Drop Mass (HADM)

Dimatix determines the calibrated drive voltage by operating each printhead with Prova model fluid, at a prescribed pulse width, operating temperature, etc. Test voltage is iterated until the average drop mass, produced by all jets firing simultaneously, matches the target value drop mass.

When using the printhead, the way to achieve the best output is to start with the calibrated voltage, then apply any correction necessary for the special application. This correction should take into account the ink used, the specific application's operating temperature and pulse width, and the target drop size particular to the application's resolution or substrate. The correction offset is typically determined during the development phase of the printing system, and held constant thereafter unless specifications change.

13.2 Printhead Positioning

13.2.1 Orientation

The SG-1024/M-C printhead is intended for use in the down spitting orientation.

13.2.2 Registration

This printhead is designed with high precision surfaces to enable drop in mounting. For any applications that demands sub-pixel drop placement accuracy, an additional registration mechanism may be required. Some implementations accomplish this by precisely locating the first and last nozzles, either optically or by printing a test image, then locking the entire printhead assembly into a mounting bracket. Others provide the capability to adjust the nozzle plate position through features built into the print mechanism.

13.2.3 Temperature

The viscosity of the ink in the nozzles is a critical parameter affecting jetting performance, and the temperature of the ink is a critical factor affecting the viscosity. Therefore, it is important to understand the viscosity/temperature characteristics of the ink and to maintain its required temperature in the printhead.

For optimal image quality it is important that the viscosity of the ink remain constant, and within a range of 10 to 16 cP. See the *Thermal Interface* section of this manual for more information regarding heaters and thermistors. The modules are heated from the mounting plate through the collar assembly. Additionally, each module has a thermistor for monitoring purposes.

13.3 Jetting Fluid Properties

A complete specification of ink properties is outside the scope of this document. The following list briefly touches on some of the more important characteristics:

Viscosity – In general terms, less viscous fluids are under-damped, prone to swallowing air during drop ejection at high frequencies, and are likely to produce satellites. More viscous fluids require higher fire pulse amplitudes to eject drops; the higher energy can introduce vibrations that contribute to crosstalk. Also note that the measured bulk viscosity may differ from what the print engine experiences due to shear rate dependencies.

Surface Tension – Adequate surface tension is essential in order to produce well formed drops with minimal satellites and minimal pooling on the nozzle plate.

Open Time – For volatile or self-drying jetting fluids, the open time is a measure of how long the nozzles remain operable if inactive. Inks with an open time of less than one minute can be successfully jetted, provided there are means in place to prevent nozzle drying. For high image quality applications, the relevant open time is defined as how long the jet can remain inactive, yet still produce drops within specification when required. Methods to control nozzle drying (also known as “decap”) may include:

- spitting each jet into a gutter during scans
- randomly firing jets in white space to exercise each jet
- low frequency jetting while idling
- subpulsing, i.e. driving the jets at all times with pulses of smaller width or amplitude that are too small to produce drops
- using a capping mechanism

Particle Size – The maximum recommended pigment particle size is 2 microns.

Vapor Pressure – Dimatix printheads utilize active refill into the pumping chamber to enable high frequency jetting of relatively high viscosity fluids. The excitation of a channel in the PZT produces a negative pressure pulse to draw the ink into the chamber. High vapor pressure fluids can cavitate during the negative pressure pulse and defeat the pumping mechanism. As an example of the acceptable range, fluids like water and acetates have been successfully jetted, whereas isopropyl alcohol and acetone do not jet properly.

13.3.1 Materials Compatibility

Full materials compatibility between the materials used in a printhead and the jetting fluid is absolutely critical for ensuring good performance and long life of the product. The Interface Control Drawing provides a list of materials in contact with the jetting fluid. Samples of these materials can be provided to support ink qualification tests.

13.3.2 Jetted Materials

Typical jetted materials for this product are expected to be oil based ceramic inks. The inks can contain both pigments and dyes, and may be slightly conductive. Inks need to contain particles no larger than 2 microns in diameter and be filtered to a 5 micron level upstream of the printhead.

13.3.3 Maintenance Materials

Solvents may be used to flush the printhead for maintenance purposes. However, the class of solvent used should be compatible with the wetted materials.

13.3.4 Fluid Changeover

During a long purge maintenance procedure, it is desirable to displace the fluid from within the printhead with degassed ink from the lung when degassing is being used. Thus it is important to know the internal fluid volume downstream of the degasser, up to and including the printhead.

13.4 Fire Pulse Considerations

13.4.1 Fire Pulse Amplitude

Refer to the calibrated voltage value on the coupons (included with the printhead) for determining the nominal FPA with model fluid for each module. The amplitude may need to be adjusted to accommodate for ink properties and printhead to printhead variations.

13.4.2 Fire Pulse Width

The printhead can operate over a broad range of pulse widths.

13.4.3 Fire Pulse Rise Time

The performance of the printhead is relatively insensitive to this parameter, with variations ranging from the minimum to the maximum recommended values having minimal impact. The specified typical value represents the operating point where Dimatix has the most experience for this product.

13.4.4 Fire Pulse Fall Time

As with the fire pulse rise time, the upper limit of the fire pulse fall time is determined by the current limit of the driver chip. Variation of this parameter can affect drop formation. However, most applications are able to more easily control drop formation through other changes in the operating conditions, including fire pulse amplitude and width, temperature, and jetting fluid physical properties. The specified typical value represents the operating point where Dimatix has the most experience for this product.

14.0 Absolute Maximum Ratings

For best results and to avoid damage, operate the printhead within the minimum and maximum ratings.

15.0 Maintenance

15.1 Purging

15.1.1 Air Pressure Purge

Air Pressure purges are commonly used because they are simple to implement. Typically a regulated pressure is applied for a fixed amount of time at the air interface to the ink reservoir attached to the printhead. The amount of pressure and the length of time are dependent on the intended purpose of the purge.

15.1.1.1 Long Purge

A long purge is used to push air bubbles out of the nozzles, transfuse deaerated ink into the printhead (in implementations where a lung is employed), and to clear clogs. A long purge is typically part of the startup procedure. When a lung is used, the ideal volume displacement is a function of lung capacity and downstream internal ink volume. The purge pressure and duration (psi-seconds) can be established once the printhead flow resistance has been determined.

15.1.1.2 Short Purge

A short purge is used to flush debris from the nozzles and re equilibrate meniscus (especially after wiping). In a short purge, very little fluid is expelled compared to a long purge.

For either type of purge, the applied pressure must be greater than the rock trap bubble pressure of 65 mBar [1.0 psi]. Empirically, Dimatix has had good results with a purge pressure as low as 100 mBar [1.5 psi], although a higher pressure up to 275 mBar [4.0 psi] is recommended for initial priming and wetting of internal surfaces.

15.1.2 Vacuum Purge

An alternative to a pressure purge is the vacuum purge. In a vacuum purge, an airtight seal is formed around the nozzles and a vacuum is applied. The same strategies as described for the pressure purges apply. Because of the difficulty in providing a good face seal, vacuum purges are typically not implemented except in systems where capping is also required.

15.2 Wiping

Wiping is a common maintenance procedure to clear debris and reestablish uniform wetting around the nozzles.

15.2.1 Manual Wiping

For manual wiping, use a clean, cleanroom wipe. Wiping materials must be compatible with printhead materials and jetting and maintenance fluids. Manual wiping may be performed on a routine preventative basis or only after a jetting anomaly is detected. Manual wiping requires good operator training and discipline to prevent unnecessary damage to the printhead.

15.2.1.1 Manual Wiping Technique

When wiping the nozzle plate the clean room wipe may become frayed. To minimize the chance of fraying the wipe and dragging debris into the nozzles, we highly recommend the following wiping technique.

1. Place wipe in middle of the nozzle plate.
2. Wipe in one direction.
3. Remove wipe from nozzle plate and fold the wipe to expose a clean surface.
4. Place wipe in middle of nozzle plate and wipe in the opposite direction.

15.3 Capping

Volatile or self-drying inks may require capping when not in use to prevent build-up around nozzles. Periodic jetting of ink while not printing can extend the time before capping must take place. Elastomeric material selection must take into consideration long-term materials compatibility. If capping is required, the addition of a vacuum purge capability to the cap can be useful and easily implemented.

15.4 Flushing

The flushing process displaces the application ink and clears all ink passages within the printhead and nozzle plate. This is done for several reasons: clearing clogged jets, ink changeover, short or long term storage.

Interface Control Drawings

1.0 SG-1024/M-C Printhead – ICD# 23865

NOTES:

1. RECOMMENDED MOUNTING SURFACES. CUSTOMER MATING SURFACE SHOULD BE FLAT TO 0.06MM AS DEFINED BY DATUM -A-

2. ALTERNATE MOUNTING SURFACES. CUSTOMER MATING SURFACE SHOULD BE FLAT TO 0.06MM AS DEFINED BY DATUM -A-

3. ALL DIMENSIONS APPLY AT 20 DEG C

4. M3 X 0.5 CAPTIVE HEAD MOUNTING SCREW(3 SUPPLIED), 2.5 INTERNAL HEX DRIVE. SCREW MAY BE USED IN TOP DOWN OR BOTTOM UP MOUNTS. IN TOP DOWN MOUNTS, RECEIVING HOLE SHOULD BE 4.5 DEEP, FLAT BOTTOMED AND THREADED 3.5 DEEP TO ACHIEVE 12N CLAMPING FORCE WITH SUPPLIED SPRING. SEE PRODUCT MANUAL FOR DETAILS ON RECOMMENDED MOUNTING. MAX TORQUE = 0.4 N·m

5. FEATURES FOR EXTERNAL HEATER AND THERMISTOR,
   - THERMISTOR: ∅1.990±0.050, 56 DEEP
   - HEATER: ∅3.230±0.50, 84 DEEP. HEATER OPTION UTILIZES HOLE.

6. HUMAN AND MACHINE READABLE (2D CODE DATAMATRIX) SERIAL NUMBER.

7. PRECISION ALIGNMENT FEATURES

8. PRECISION SURFACE FOR APPLYING ALIGNMENT FORCE

9. LOCATION OF CENTER OF GRAVITY (C OF G)

10. DEFINITION OF JET NUMBER (JET 1) AND ROW AND NOZZLE (R3,N1)

11. THERE ARE 3 NON-FUNCTIONAL, BLANKED OFF, HOLES IN THE NOZZLE PLATE IN EACH ROW, BEFORE THE FIRST AND AFTER THE LAST FUNCTIONAL JET .

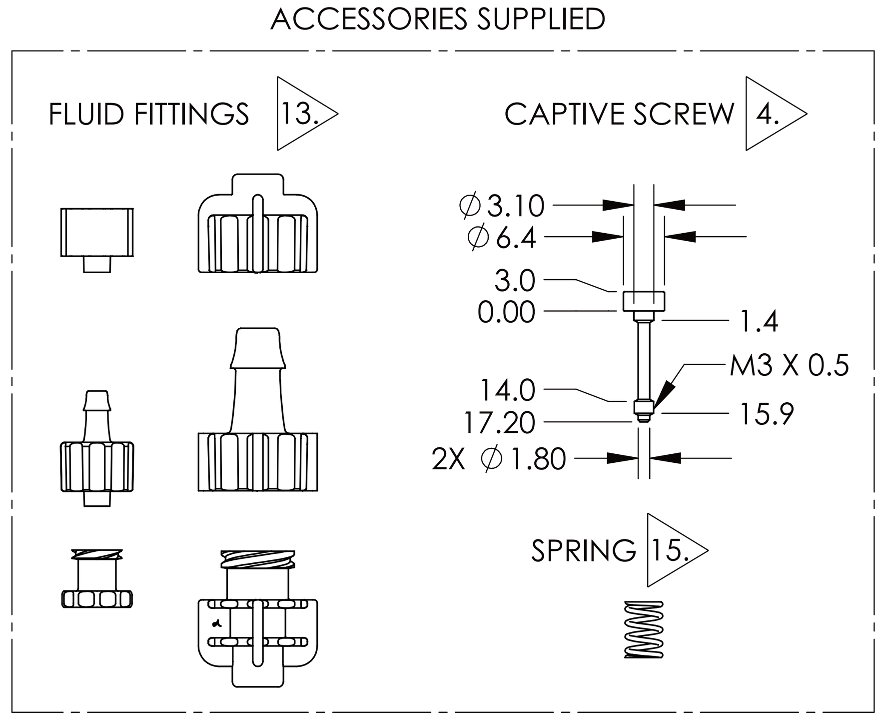
12. HIGH LOCALIZED PRESSURE, SUCH AS THE PRESSURE REQUIRED TO COMPRESS AN O-RING, SHOULD NOT BE APPLIED IN THIS AREA. SEE PRODUCT MANUAL FOR RECOMMENDATIONS.

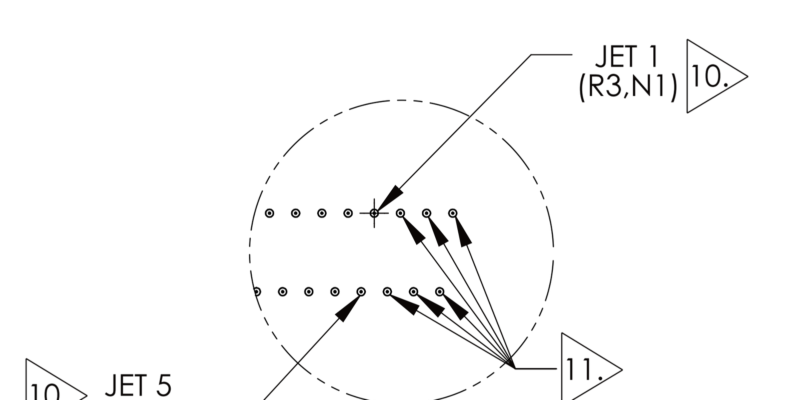
13. FLUID FITTINGS PROVIDED WITH PRINTHEAD: 2 MALE PLUGS, LUER AND LARGE TAPER, INSTALLED. 2 MALE TUBING ADAPTERS, MALE LUER-3.2 ID TUBE AND MALE LARGE TAPER-6.4 ID TUBE, SEPERATE. 2 FEMALE CAPS, LUER AND LARGE TAPER, SEPERATE.

14. BORDER AROUND NOZZLE PLATE COATED WITH SPECTRA EPOXY

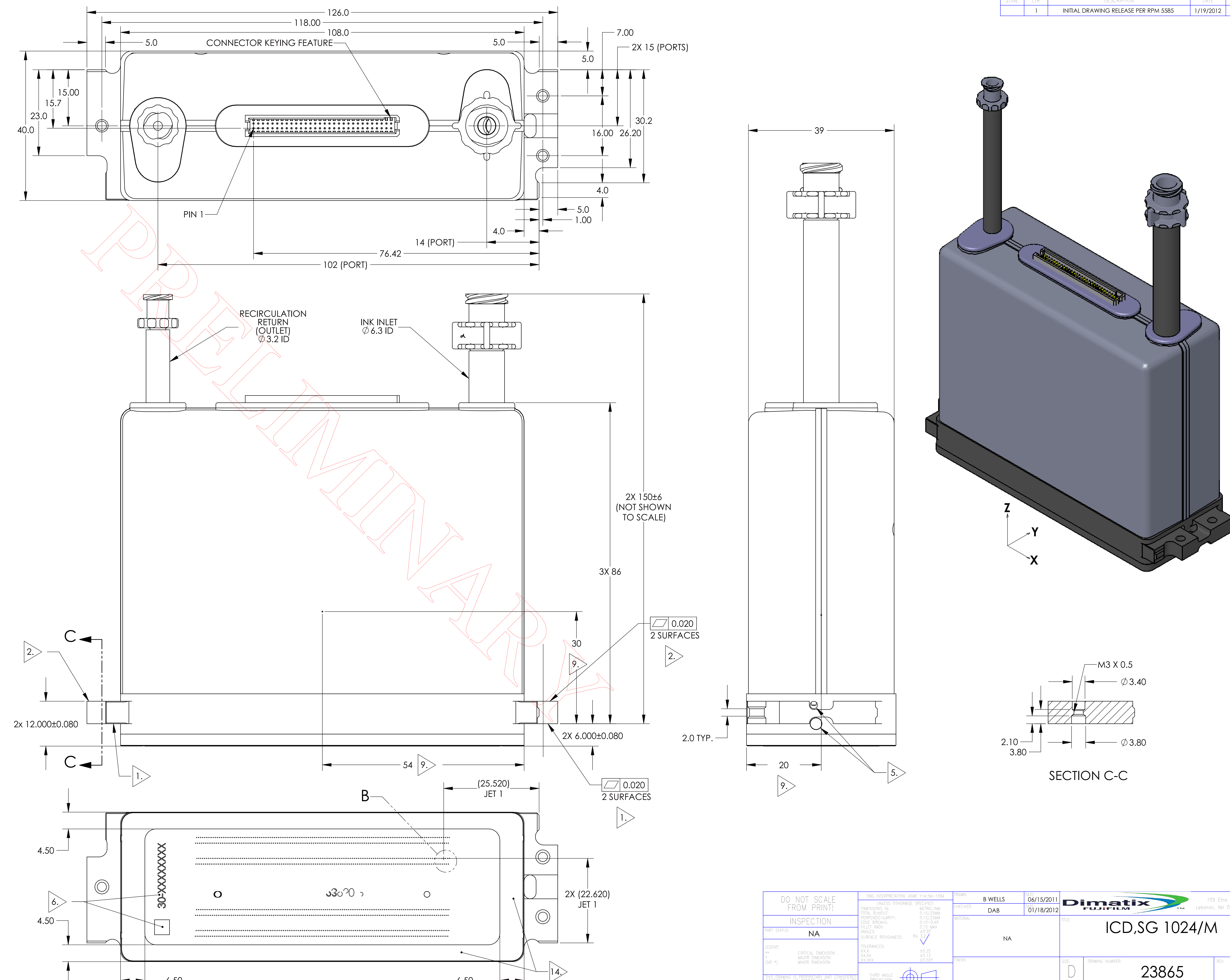
15. SPRING (3 SUPPLIED):
   MATERIAL: STAINLESS STEEL. FREE LENGTH = 8.64
   OD = 5.9 ID = 4.4 SPRING RATE = 6.1 N/MM

ACCESSORIES SUPPLIED





DETAIL B
SCALE 8 : 1



ZONE	LTR	DESCRIPTION	DATE	REVISED BY
	1	INITIAL DRAWING RELEASE PER RPM 5585	1/19/2012	RLW

DO NOT SCALE FROM PRINT!

INSPECTION: NA

DWG. INTERPRETATION: ASME Y14.5M-1994

UNLESS OTHERWISE SPECIFIED: DIMENSIONS IN METRIC/MM

THIRD ANGLE PROJECTION

DRAWN	B WELLS	06/15/2011
CHECKED	DAB	01/18/2012
MATERIAL	NA	
FINISH		
FILE NAME	23865.SLDDRW	

Dimatix FUJIFILM — 109 Etna Road, Lebanon, NH 03766 USA

TITLE: ICD,SG 1024/M

SIZE: D DRAWING NUMBER: 23865 REV: 1

SCALE: 2:1 SHEET: 1 OF 2

ZONE	LTR	DESCRIPTION	DATE	REVISED BY
	1	INITIAL DRAWING RELEASE PER RPM 5585	1/19/2012	RLW

MATERIALS IN CONTACT WITH INK (IN THE FLUID PATH)

MATERIAL	PART OR ASSEMBLY
RESIN FILLED CARBON	ACTUATOR BODY, COLLAR, MANIFOLD
POLYIMIDE (UPILEX)	FLINK, ROCK TRAP
17-7 STAINLESS STEEL	ACTUATOR AND COLLAR LAMINATES
303 STAINLESS STEEL	COLLAR BARBS
PALLADIUM-NICKEL	NOZZLE PLATE
PARYLENE	ACTUATOR ASSY
VITON	INK TUBING
SPECTRA EPOXY	ACTUATOR AND COLLAR ASSYS
BARB EPOXY	COLLAR ASSY
NYLON	FLUID CONNECTORS

MATERIALS IN OCCASIONAL CONTACT WITH INK

MATERIAL	PART OR ASSEMBLY
ACETAL	COVER
FLUORO SILICONE	COVER SEALS
LIQUID CRYSTAL POLYMER	CONNECTOR HOUSING

TYPICAL THERMAL EXPANSION VALUES

PART OR ASSEMBLY	THERMAL EXPANSION
NOZZLE PITCH (X)	7.1 PPM/°C
NOZZLE PITCH (Y, ROW TO ROW)	11 PPM/°C
JET 1 TO XREG SURFACE	7.8 PPM/°C
MEASURED UNCONSTRAINED	

COMPONENT DETAILS

THERMISTOR	MFG: MURATA PN: NXFT15X103FA2B150
HEATER (OPTION)	30W, 24V DC or AC(RMS)
LVDS RECIEVER	MFG: NATIONAL SEMICONDUCTOR PN: DS90C032BTM/NOPB

MECHANICAL PROPERTIES

MASS	320 GM
CENTER OF GRAVITY	SEE SHEET 1 + NOTE 9
FLUID VOLUME	26 CC

FLUID FITTING DETAILS 13.

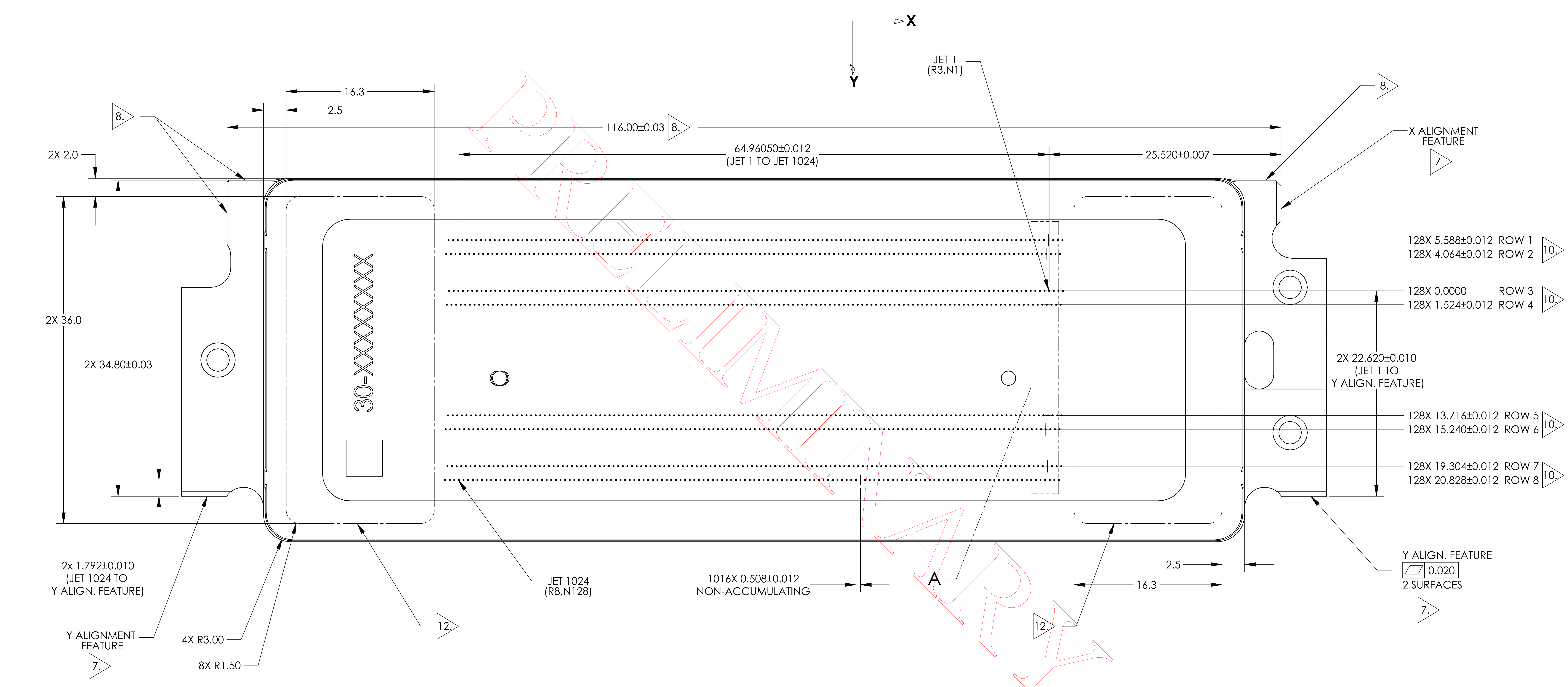
MFG: VALUE PLASTICS

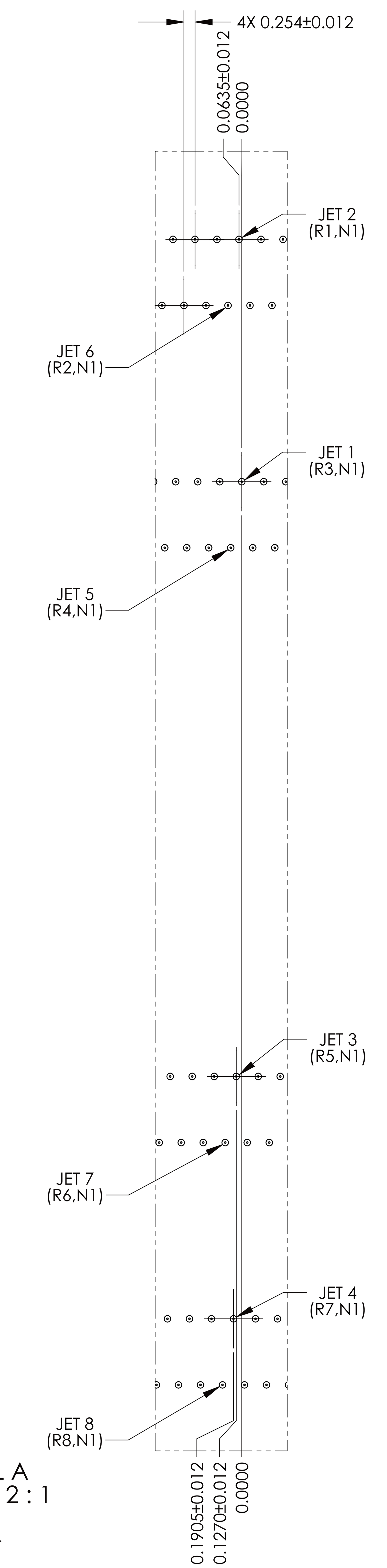
DESCRIPTION	MFG PN
FEMALE LUER TO 3.2 BARB (INSTALLED)	FTLL013-1
FEMALE TAPER LOC TO 6.3 BARB (INSTALLED)	FLB055-1
MALE LUER PLUG	LP4-1
MALE TAPER LOC PLUG	MLBP-1
MALE LUER TO 3.2 BARB	MTLL013-1
MALE TAPER LOC TO 6.3 BARB	MLB055-1
FEMALE LUER CAP	FTLLP-1
FEMALE TAPER LOC CAP	FLBP-1

Jet Mapping Data

Row	Jets	Connector Pins	Pixel Numbers (column)
1	2, 10, 18, 26, ..., 1018	13, 14	1022, 1014, 1006, ... 6
2	6, 14, 22, 30, ..., 1022	15, 16	1018, 1010, 1002, ... 2
3	1, 9, 17, 25, ..., 1017	17, 18	1023, 1015, 1007, ... 7
4	5, 13, 21, 29, ..., 1021	19, 20	1019, 1011, 1003, ... 3
5	3, 11, 19, 27, ..., 1019	21, 22	1021, 1013, 1005, ... 5
6	7, 15, 23, 31, ..., 1023	23, 24	1017, 1009, 1001, ... 1
7	4, 12, 20, 28, ..., 1020	25, 26	1020, 1012, 1004, ...4
8	8, 16, 24, 32, ..., 1024	27, 28	1016, 1008, 1000, ... 0

See product manual for complete details





DETAIL A
SCALE 12 : 1
10.

INTERCONNECT

Samtec TFM-130-32-L-D-A-K

Pin Num.	Connection	Description	Pin Num.	Connection	Description	Pin Num.	Connection	Description	Pin Num.	Connection	Description
1	GND	Head Common	13	D0_N	Negative LVDS Data signal serial input for Row 1-128 Nozzle HV outputs	29	GND	Head Common	45	GND	Head Common
2	VCC	5.0V DC Logic power for driver chips	14	D0_P	Positive LVDS Data signal serial input for Row 1-128 Nozzle HV outputs	30	GND	Head Common	46	FP0	Fire Pulse tied to Row 1
3	GND	Head Common	15	D1_N	Negative LVDS Data signal serial input for Row 2-128 Nozzle HV outputs	31	GND	Head Common	47	GND	Head Common
4	VCC	5.0V DC Logic power for driver chips	16	D1_P	Positive LVDS Data signal serial input for Row 2-128 Nozzle HV outputs	32	SCL	I2C Clock signal for Serial Interface	48	FP1	Fire Pulse tied to Row 2
5	GND	Head Common	17	D2_N	Negative LVDS Data signal serial input for Row 3-128 Nozzle HV outputs	33	GND	Head Common	49	GND	Head Common
6	GND	Head Common	18	D2_P	Positive LVDS Data signal serial input for Row 3-128 Nozzle HV outputs	34	SDA	I2C Data signal for Serial Interface	50	FP2	Fire Pulse tied to Row 3
7	CLK_N	Negative LVDS Data Clock Signal for driver chips – this clock fed into 4 clock buffers and distributed from there.	19	D3_N	Negative LVDS Data signal serial input for Row 4-128 Nozzle HV outputs	35	THB	Print Head Thermistor	51	GND	Head Common
			20	D3_P	Positive LVDS Data signal serial input for Row 4-128 Nozzle HV outputs	36	THA	Pull Up for Print Head Thermistor	52	FP3	Fire Pulse tied to Row 4
8	CLK_P	Positive LVDS Data Clock Signal for driver chips – this clock fed into 4 clock buffers and distributed from there.	21	D4_N	Negative LVDS Data signal serial input for Row5-128 Nozzle HV outputs	37	HTRB	Ground for Print Head heater	53	GND	Head Common
			22	D4_P	Positive LVDS Data signal serial input for Row 5-128 Nozzle HV outputs	38	HTRA	Control for Print Head Heater	54	FP4	Fire Pulse tied to Row 5
9	GND	Head Common	23	D5_N	Negative LVDS Data signal serial input for Row 6-128 Nozzle HV outputs	39	GND	Head Common	55	GND	Head Common
10	GND	Head Common	24	D5_P	Positive LVDS Data signal serial input for Row 6-128 Nozzle HV outputs	40	GND	Head Common	56	FP5	Fire Pulse tied to Row 6
11	LAT_N	Negative LVDS Data Latch Signal for driver chips – this control signal is shared by all (32) driver chips	25	D6_N	Negative LVDS Data signal serial input for Row 7-128 Nozzle HV outputs	41	HTRB	Ground for Print Head heater	57	GND	Head Common
			26	D6_P	Positive LVDS Data signal serial input for Row 7-128 Nozzle HV outputs	42	HTRA	Control for Print Head Heater	58	FP6	Fire Pulse tied to Row 7
12	LAT_P	Positive LVDS Data Latch Signal for driver chips – this control signal is shared by all (32) driver chips	27	D7_N	Negative LVDS Data signal serial input for Row 8-128 Nozzle HV outputs	43	GND	Head Common	59	GND	Head Common
			28	D7_P	Positive LVDS Data signal serial input for Row 8-128 Nozzle HV outputs	44	GND	Head Common	60	FP7	Fire Pulse tied to Row 8

DO NOT SCALE FROM PRINT!

INSPECTION: NA

DRAWN	B WELLS	06/15/2011
CHECKED	DAB	01/18/2012
MATERIAL	NA	
FILE NAME	23865.SLDDRW	

Dimatix FUJIFILM — 109 Etna Road, Lebanon, NH 03766 USA

ICD,SG 1024/M

SIZE: D — DRAWING NUMBER: 23865 — REV: 1

SCALE: 1:1 — SHEET: 2 OF 2

Specifications

1.0 SG-1024/M-C Printhead Product Specification – #23669

FUJIFILM Dimatix

Product Specification

SG – 1024/M-C

1. SCOPE

1.1. This document describes the performance and interface requirements for SG-1024/M–C printheads.

2. RELATED MATERIAL

2.1. Interface Control Drawing 23865

2.2. Final Acceptance Test Procedure Using Model Fluid

2.3. Waveform files

2.4. Product Manual

3. DEFINITIONS

3.1. Crosstalk: The impact of firing neighboring jets on drop volume and velocity. This document refers to velocity crosstalk only. Crosstalk is measured as a percent change in jet velocity of a given jet when neighboring jets are turned on, $(V_{many}-V_{alone})/V_{alone}$.

3.2. Velocity Crosstalk, Average: This is the average cross talk of the entire population of printheads manufactured. This value is intended to indicate typical printhead performance.

3.3. Velocity Crosstalk, Average, max: This is the upper specification limit for the average cross talk of any individual printhead. This average indicates the average of each jet on an individual printhead.

3.4. Drop Mass Variability: Drop mass variability is the measured difference between each individual module drop mass (4 modules) from the average module drop mass where the individual module drop mass is measured using the calibration voltage (FPA). The average is the sum of the four drop mass values/4 or $(dm_{modele1\text{-}4})/4$.

3.5. Drop Velocity: The drop velocity is calculated by dividing a given standoff distance by the time it takes from the initiation of a fire pulse (including multi-pulse waveforms) for a drop to travel to the specified standoff.

3.6. FPA: Calibration voltage to achieve the target drop mass for single pulse at standard test conditions.

3.7. HADM: Head Average Drop Mass, defined as the average drop mass for all jets on all PZTs.

3.8. HIB: : Head Interface Board

3.9. ICD: Interface Control Drawing.

3.10. Jet Straightness: The angular trajectory error for each jet in the printhead. The measurement for each jet is made by printing with the head stationary and calculating the deviation from a best-fit line for drop placement across the entire head. Knowing the standoff distance, the drop placement error is translated to an angle.

3.11. Line Width: The measured width of lines printed on a coupon. The line width measurements are normalized by the average line width of all jets and reported as a %.

3.12. Meniscus Pressure: The amount of negative pressure required to maintain the free surface in the nozzles of the printhead. Meniscus pressure is usually controlled in the ink reservoir (with a free surface) that supplies the printhead.

3.13. mrad: Milliradian.

3.14. ng: Nanogram

3.15. ng-kHz: This describes a measure of productivity and is calculated by multiplying drop mass in ng by frequency in kHz

3.16. PADM: PZT Average Drop Mass, defined as the average drop mass for all jets on a single PZT.
3.17. pF: picoFarad.
3.18. Standoff: the distance measured between the nozzle plate and the substrate.
3.19. Recirculation: the movement of ink through the printhead where ink in excess of that required for printing is introduced to the printhead and then pulled through the printhead to be fed back to the ink delivery system.

4. STANDARD TEST CONDITIONS

4.1. *Common Conditions for All Drop Sizes and Product Models:*

4.1.1. **Meniscus pressure** ....2.5 cm H_2O (1.0 in. H_2O, .5 kPa) at the nozzle plate
4.1.2. **Orientation** ....down spitting
4.1.3. **Standoff; line width & straightness measurements**..1.5mm (.060 in.)
4.1.4. **Standoff; velocity measurements** 0.75 mm (0.03 in.)
4.1.5. **Test fluid.......................................**Dimatix Prova (Purple)
4.1.6. **Operating temperature** ....33ºC (to achieve 10-11 cP fluid viscosity)
4.1.7. **Recirculation pressure ....**51 cm H_2O below inlet pressure (5 kPa, 20 in H_2O)

4.2. *Specific Conditions*

	SG-1024/M-C	
Drop Size	**Small**	**Large**
Waveform File	24368	24369
Frequency	8 kHz	4 kHz
Target Drop Mass	27 ± 1.0 ng	65 ± 1.0 ng
Slew Rate	30 V/µsec	30 V/µsec
Calibrated Voltage	Voltage to achieve Target Drop Mass	

5. SPECIFICATIONS

5.1. *General Product Description*

5.1.1. **Number Of Jets**.............................1024
5.1.2. **Nozzle Arrangement** ....Eight rows of 128 nozzles
5.1.3. **Nozzle Spacing** ....0.0635 mm (0.0025 in.)
5.1.4. **Print Width** ....64.9605 mm (2.5575 in.)
5.1.5. **VersaDrop™ Maximum Productivity**
5.1.5.1. **SG-1024/M-C*** ....1080 ng-kHz with drop sizes between 27 to 65ng
*maximum frequency for single pulse drop is 40 kHz
5.1.6. **VersaDrop™ Pulse Amplitude, Maximum**
5.1.6.1. **SG-1024/M-C** ....130 volts
5.1.7. **Range of Fire Pulse Amplitude (FPA) for Single Pulse Operation**
5.1.7.1. **SG-1024/M-C** ....80 to 120 volts

5.1.8. **Operating Temperature, Maximum** ……..60°C
5.1.9. **Recirculation Port Pressure** ....5 kPa (50.8 cm H2O, 20 ± 2 inches H_2O)

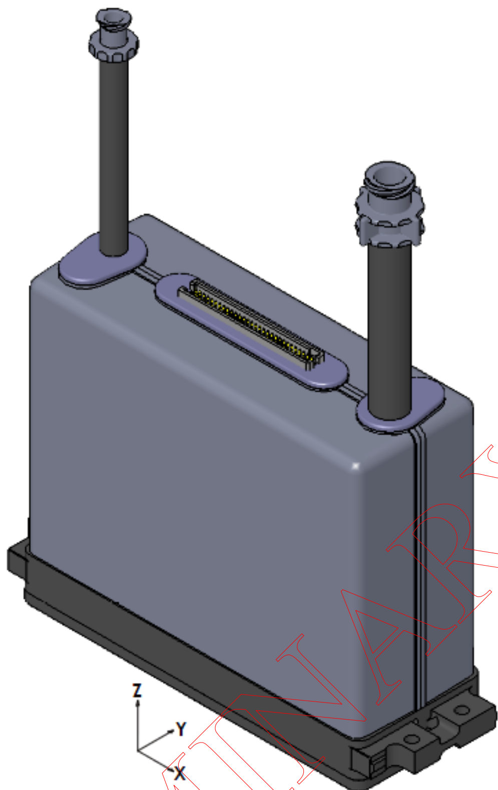


Figure 1: SG-1024/M-C

5.2. *Specific Product Descriptions*

	SG-1024/M-C	
Drop Size	**Small**	**Large**
Drop Mass Variability, Absolute, maximum (%)	*10*	*10*
Line Width, maximum deviation from mean (%), ±	*12*	*12*
Line Width variability, one **σ** (%), max, by module	*4.0*	*4.0*
Drop Velocity, Mean, range of population (m/s), by PZT	*6-10*	*6-10*
Drop Velocity Variability, one **σ**, m/s, by PZT	*0.5*	*0.5*
Velocity Crosstalk, Average (%)*	*>-12*	*>-12*
Velocity Crosstalk, Average, max (%)*	*-15*	*-15*
Jet Straightness, X-axis Error, maximum (See Figure 1, mrad), ±	*20*	*20*
Jet Straightness, X-axis Variability, one **σ**, max (mrad)	*3.5*	*3.5*

	SG-1024/M-C	
Drop Size	**Small**	**Large**
Jet Straightness, Y-axis Error, maximum (See Figure 1, mrad), ±	*30*	*30*
Jet Straightness, Y-axis Variability, one **σ**, max (mrad)	*4.5*	*4.5*
* Crosstalk can be reduced by changing pulse width, operating frequency, and other operating parameters.		

5.3. *Reliability*

5.3.1. **Product Life**............................... This product is designed to withstand the following with less than 10% decrease in head average drop mass at standard test conditions:

5.3.1.1. 100 billion single pulse actuations per jet

5.3.1.2. 12 months of normal exposure to compatible fluids, section 5.5*

*****Printheads can be refurbished.

5.4. *Materials Compatibility*

5.4.1. **Jetted and Flushing Fluid Materials**…...The products have been designed to be compatible with fluids of the following type:

5.4.1.1. Ceramic inks*

5.4.1.2. Dimatix Prova, purple test fluid

*****Performance and reliability with any given fluid must not be assumed without assurance of sufficient testing of that fluid with this product. Please inquire with Dimatix Technical Support.

5.5. *Operating Environmental Conditions at Printhead*

5.5.1. **Temperature** ....10 – 55 °C

5.5.2. **Humidity** ....10 –90% R.H., non-condensing

5.5.3. **Dust**...Care should be taken to reduce dust and particulate in the environment adjacent to the printhead. Reductions in airborne particulate will reduce overall maintenance required.

5.5.4. **Acceleration** ....Product designed for applications where the printhead is stationary. Some deterioration in jetting performance is expected if required to print during acceleration. Evaluate product performance if using in non-stationary application.

5.6. *Mechanical Interface*

5.6.1. The mechanical interface with dimensions of the products is defined on the Interface Control Drawings.

5.7. *Electrical Interface*

5.7.1. **Fire Pulse Amplitude, maximum**... The products will not suffer permanent damage up to 150 volts. Fire Pulse Amplitudes are dependant upon the application and should be evaluated prior to system design.

5.7.2. **Slew Rate, maximum**....................The products will not suffer permanent damage at a maximum slew rate of 80 volts/µsec. The slew rate is dependant upon the application and should be evaluated prior to system design.

5.7.3. **Capacitance SG-1024/M** ....The typical equivalent capacitance for any channel is 145, with a maximum equivalent capacitance of no more than 165pF at room temperature (~23°C).

5.7.4. **Thermistor** .... An active thermistor is permanently mounted in the middle of the head and is electrically accessible through the main printhead connector. See the ICD and the SG-1024 HIB Electrical Specification for interface and thermistor properties.

5.7.5. **Heater(s)**.......................................Internal and external heaters. Heating is facilitated through the mounting features. A heater etc. See the ICD for details.

5.7.6. **Data Path**......................................Refer to the SG-1024 Electrical section in the product manual

5.7.7. **Data Chip** ....file format, s/n, p/n, FPA

5.8. *Maintenance*

5.8.1. **Nozzle Plate Maintenance** ....Nozzle face of printhead will accommodate common industry procedures of wiping, capping, and vacuum purging. See the ICD for design considerations for capping the printhead.

5.8.2. **Purge Pressure, maximum**........30 kPa (0.30 bar, 4 psig)

5.9. *Regulatory Compliance*

5.9.1. **CE, UL** ....Products are not tested for regulatory compliance (either CE or UL). The OEM is responsible for ensuring the end product is compliant with the appropriate regulatory requirements.

5.9.2. **RoHS/WEEE** ....Printhead is RoHS/WEEE compliant. Please contact Dimatix Technical Support for the specific standard and supporting data.

5.10. *Shipping & Packaging*

5.10.1. **Temperature** .... The products can be shipped or stored at temperatures between –40 and 65°C.

5.10.2. **Humidity** .... 10 – 90% non-condensing relative humidity

5.10.3. **Packaging** .... The product is packaged in a two piece RPET box with anti-static properties. Fittings and screws are included in the box for use with the printhead. See the product manual for more information.

5.10.4. **Altitude**.. Suitable to be shipped by air.

5.10.5. **Residual Fluids** .... Product will be shipped with a residual amount of shipping fluid.

5.10.6. **Product Marking**.......................... The product's packaging is clearly marked with the Dimatix part number, serial number, FPA, and Pitch. The Dimatix® logo is visible on the printhead.

5.10.7. **Serial Number**............................... Product serial number is indicated with both human readable and barcode markings on printhead and on the packaging.

5.10.8. **Shelf Life** .... 12 months.

5.10.9. **Shock and Vibration** .... as defined in ISTA 1A 2001 3A

5.10.10. **Print Test Coupon** .... Provided.

5.11. ***Refurbishment***

5.11.1. This product is designed to facilitate refurbishment. Please contact Dimatix for the service policy for this product.

5.12. ***Disposal***

5.12.1. This product is constructed with materials containing lead and needs to be disposed in accordance with the RoHS/WEEE and/or other applicable regional regulations.

2.0 SG-1024 Flex EEPROM Data Format and Interface Specification

SG-1024 Flex EEPROM Data Format and Interface Specification

George Baker 12/06/11
FUJIFILM Dimatix, Inc.

date	rev	
02/14/12	1.2	GLB: Removed Blank & Polarity descriptions. Updated SCL description to explicitly state that this signal is bidirectional. Update format description of data stored in EEPROM.
12/08/11	1.1	GLB: Updates per spec review.
12/06/11	1.0	GLB: Original version

Table of Contents

1 Introduction

This document describes the interface to the SG-1024 flex EPROM and the format of the data stored in this EEPROM. The physical memory is the on-chip EEPROM of a Microchip PIC 16F1823 14-pin TSSOP microprocessor mounted on the print head's flex. Firmware running on this micro supports read/write access to the data via an I2C interface (see the Host/Print Head Data Manager interface section for the details of this interface). Each of the SG-1024's flexes has its own EEPROM used to store data related the flex For the purpose of this spec, the chip and firmware package are referred to as the Print Head Data Manager.

Each flex of the print head assembly's 8 flexes has a unique address. These addresses [0x50..0x57] are determined by 3 address lines from the HIB. The HIB is designed so that rows 1, 2, 3, 4, 5, 6, 7, 8 correspond to addresses 0x50, 0x51, 0x52, 0x53, 0x54, 0x55, 0x56, 0x57. Each flex's Print Head Data Manager reads the address lines during initialization and determines its address.

The Print Head Data Manager also stores the PZT/calibration information (up to 61 bytes) in the PIC's EEPROM. The PZT information is similar to the module ID information that is currently stored on a Sapphire module's Dallas EEPROM chip. There is also a 64 byte area of EEPROM reserved for customer use. The host controller can read and write to the 64 byte area of EEPROM reserved for customer use at any time, but access to the 61 bytes of PZT information is read-only.

EEPROM address 0xFF is the control register. The host can command the Print Head Data Manager to perform a variety of functions by writing specific values to this register.

2 Host/Print Head Data Manager Interface

The host/Print Head Data Manager communications protocol is I2C. This requires only three wires: data (SDA), clock (SCL), and ground return. SCL and SDA must be pulled up to 5 V by the host using 10K pull up resistors. The mode is 7 bit addressing, 100 KHz speed, and clock stretching is supported (see I2C-Bus Specification for details). The I2C-Bus Specification is available online at: http://www.nxp.com/documents/user_manual/UM10204.pdf. The host controller is the bus master and initiates all transactions. All transactions are either read or write transactions. If the Print Head Data Manager is busy and not able to receive a read/write command (possibly during power up sequence or EEPROM access), it alerts the host (holds I2C clock low) and the host will wait until the Print Head Data Manager is ready to receive again.

EEPROM address 0xFF is the control register. The host can command the Print Head Data Manager to perform a variety of functions by writing specific values to this register.

The Print Head Data Manager holds the I2C clock line low until it completes executing each command received. This prevents the host from sending another command before the Print Head Data Manager is ready.

2.1 Physical I2C bus

The physical I2C bus is just two wires, called SCL and SDA. SCL is the clock line. It is used to synchronize all data transfers over the I2C bus. SDA is the data line. Both SDA and SCL are bidirectional lines, connected to a 5 V supply via a 10K current-source or pull-up resistor. The output stages of the host must have an open-drain or open-collector to perform the wired-AND function. What this means is that the host can drive its outputs low, but it cannot drive them high. If the pull-up resistors are missing, the SCL and SDA lines will always be low - nearly 0 volts - and the I2C bus will not work.

Some implementations of the I2C may not use bidirectional lines for SCL. These implementations rely on delays instead of clock stretching for synchronization. This approach is not recommended. We recommend using bidirectional lines with clock-stretching supported.

2.2 Write Transactions

Each write transaction consists of the following single byte transfers:

1. Host sends a start sequence
2. Host sends I2C address of the flex with the R/W bit low. The device address is stored in the upper 7 bits and the R/W bit is in bit0 (0= write, appears as even address).
3. Host sends the EEPROM address (0x0000..0x00FF) of the byte you want to write to. This is referred to as the sub address field. It is a 2-byte field with the MSB sent first.
4. The host sends the data byte to the Print Head Data Manager.
5. The host may continue to sending data bytes to the Print Head Data Manager. The firmware increments the sub address (EEPROM byte address) by 1 on each consecutive transfer.
6. The host terminates the transaction by sending the stop sequence.

2.3 Read Transactions

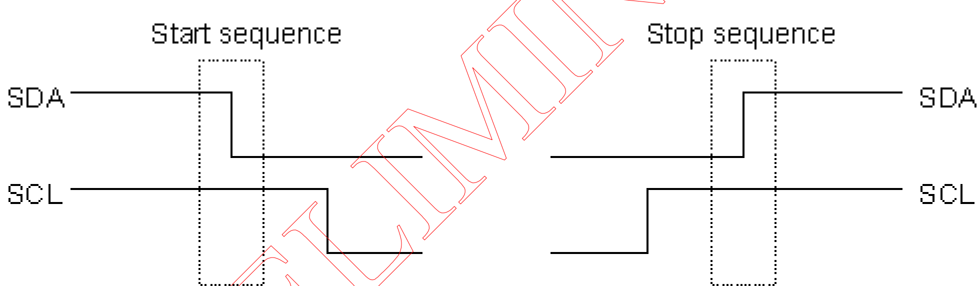
Each read transaction consists of the following single byte transfers:

1. The host sends a start sequence
2. Host sends the device address (I2C device address of the flex) with the R/W bit low (write). The device address is stored in the upper 7 bits and the R/W bit is in bit0.

3. Host sends the address (0x0000..0x00FF – MSB first) of the EEPROM byte that you want to read.
4. Host sends a start sequence again (repeated start). A start sequence is considered a repeated start if the previous transaction has not been terminated by a stop sequence.
5. Host sends I2C address of the flex with the R/W bit high. The device address is stored in the upper 7 bits and the R/W bit is in bit0 (1= read, appears as odd address).
6. The Print Head Data Manager holds the clock line low until it has read the byte at the requested address and is ready to transmit it to the host. When it is ready to transmit, the Print Head Data Manager releases the clock line and begins transmitting the requested byte, bit by bit, on consecutive clock pulses.
7. Host reads the data byte from the Print Head Data Manager.
8. The host may continue to read data bytes from the Print Head Data Manager by continuing to drive the clock without sending a stop sequence. The sub address (EEPROM byte address) is incremented by 1 on each consecutive transfer.
9. Host sends the stop sequence.

2.4 Start and Stop Sequence

A start (or restart) sequence is one of two special sequences defined for the I2C bus, the other being the stop sequence. The start (or restart) sequence and stop sequence are special in that these are the only places where the SDA (data line) is allowed to change while the SCL (clock line) is high. When data is being transferred, SDA must not change while SCL is high.



3 EEPROM Layout

0x00	Reserved
	• • • • •

0x7F	Reserved
0x80 0xBF	Reserved for Customer
0xC0 0xFC	PZT/Calibration Info
0xFD	Firmware Version
0xFE	Blank & Polarity
0xFF	Control Register

3.1 Customer Area

EEPROM byte addresses 0x80 to 0xBF are reserved for customer use. This area of EEPROM may be read or written at any time by the host. It is the customer's responsibility to mange access to this area in the host software.

3.2 PZT/Calibration Information

The upper 61 bytes of EEPROM (byte addresses 0xC0 to 0xFC) are reserved for storing the PZT info. This area of EEPROM may be read at any time by the host. This data is intended to be written once only during manufacture. This area of EEPROM is locked (write protected).

3.3 Firmware Revision

EEPROM address 0xFD is the firmware revision register. This byte holds a value between 0 and 254 to identify the firmware revision. The host may read this byte at any time. 255 is not a valid firmware version number.

3.4 Control Register

EEPROM address 0xFF is the control register. The host can command the Print Head Data Manager to perform a variety of functions by writing specific values to this register. The host can command the Print Head Data Manager to reset by writing a value of 0xF0 to the control register.

4 Data Format

- Data length – 1 Byte HEX
- File Format – ASCII

- Printhead tested level part number – ASCII
- Printhead serial number (collar serial number) – ASCII
- Date – ASCII
- Printhead calibration voltage (entire 1024-jet head) – ASCII
- Printhead drop mass offset (for this flex) – ASCII
- Nozzle pitch (mm) – ASCII
- Edge to jet 1 distance(mm) – ASCII
- Checksum – 1 Byte HEX

All fields except for the data length and CRC are ASCII strings. The Data length field is a single byte (unsigned 8-bit integer) and the CRC is 2 bytes (unsigned 16-bit integer). All fields are separated by commas (‘,’ or 0x2C) except for the data length byte and print head revision level. There is no delimiter between the data length byte and print head revision level. The CRC bytes (2) and the data length byte (1) are not included in the data length value; the length byte indicates data length only.

5 Multiple Head Systems

Each flex of the print head assembly’s 8 flexes has a unique address. These addresses [0x50..0x57] are determined by 3 address lines from the HIB. Since the flex addresses are determined by 3 address lines, the maximum number of unique addresses is 8. Each device on an I2C bus must have a unique address. This means that multiple heads may not be connected through a single I2C bus.

In systems where each head is connected to a separate controller card, there should not be any problem communicating with multiple heads. Each controller card would communicate with its head’s 8 Print Head Data Managers over an I2C bus. The communications between the print head controller card and the host could be fiber, LVDS, or something else. The key is that each controller card is an I2C master and it communicates with the 8 flexes (slave devices) of the print head it is controlling. Each head / controller card uses its own I2C bus.

Another option for systems where a card controls more than 1 head could be to use a multiplexer to switch the I2C link from head to head. The PCA9547 is an 8-channel I2C multiplexer made by NXP. For a data sheet go to:

http://www.nxp.com/documents/data_sheet/PCA9547.pdf

SG-1024/M-C Performance Data

The performance information contained in this appendix is the result of our test results using Prova Model Fluid. The following sections provide information about the Prova Model Fluid, the waveforms used in the testing, and the performance curves for single pulse (27 ng drop) and multi pulse (65 ng drop) operation.

1.0 Prova Model Fluid

The performance curves shown later in this appendix were created jetting Prova Model Fluid. Prova is a more suitable test fluid for ceramic applications. It was developed to the qualifications of viscosity (10-14 cP), surface tension (24-36 dynes/cm^2), and miscibility to ceramic inks. The following table details the physical properties of the Prova test fluid and shows the comparative values of XL-30 and 7060 model fluids.

Table C - 1 Physical Properties of Model Fluids

Properties	Prova	XL-30	7060
Viscosity (cP)	11.4 @ 30° C	10.6 @ 30° C	11.1 @ 70° C
Density (g/cm^3)	0.950 @ RT	1.082 @ RT	1.008 @ RT
Surface Tension (dynes/cm^2)	32 @ RT	38 @ RT	35 @ RT
Speed of Sound (m/sec)	1329 @ RT	1380 @ RT	1924 @ RT

The following graph shows the Viscosity Sweep for the Prova Model Fluid.

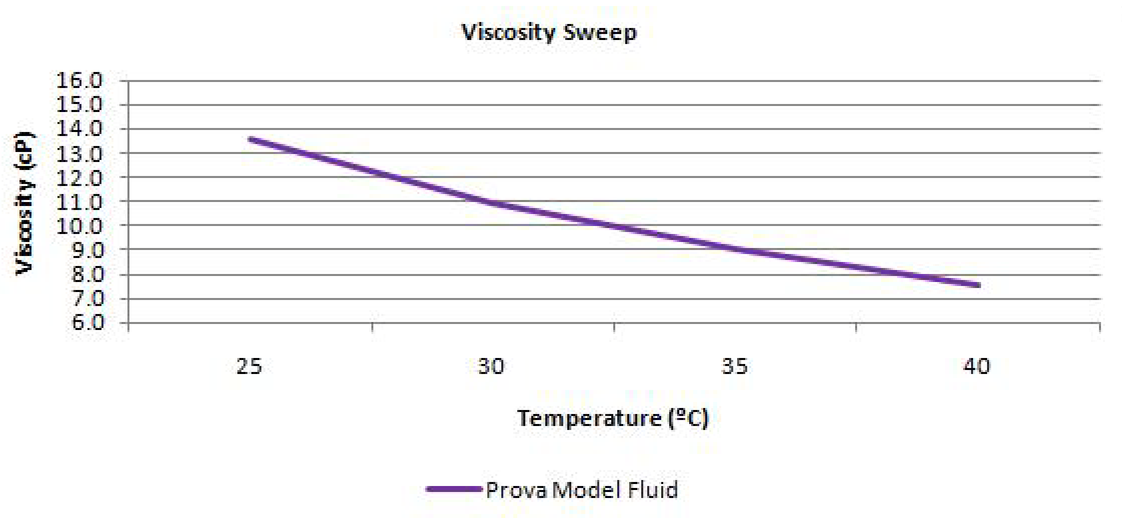


Figure C - 1 Prova Viscosity Sweep

The following graph shows the Prova Model Fluid shear rate.

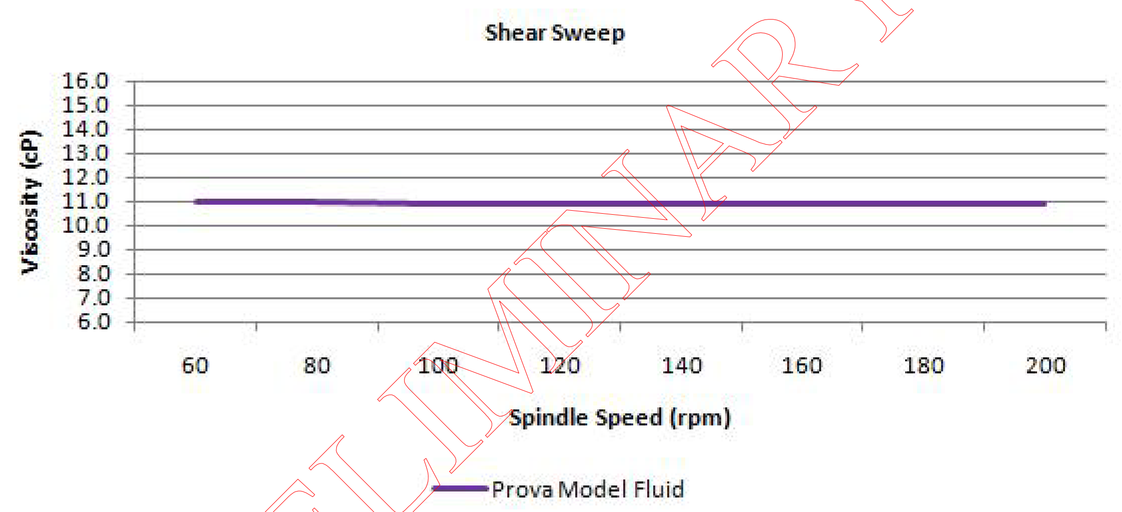


Figure C - 2 Prova Shear Rate

2.0 Printhead Attributes

Table C - 1 Printhead Attributes

Attributes	SG-1024/M-C
Number of addressable jets	1024
Nozzle spacing	0.0635 mm[0.0025 inches]
Print width	64.9605 mm [2.5575 inches]
Native resolution – printhead	400 dpi
Overall length x width x height (excluding tubing)	126 mm x 40 mm x 92 mm [4.96 inches x 1.57 inches x 3.62 inches]
Weight	320 grams (0.705 lb)
Maximum Frequency for Single Pulse	38 kHz
Range of Fire Pulse Amplitude (FPA) – Single Pulse	70 to 110 V
Capacitance	130 to 160 pF, 145 pF nominal
Operating Temperature, Maximum	60 ° C

1. All performance data indicate typical response jetting under standard test conditions.
2. Velocity data is indicative of performance at a fixed frequency of operation.

3.0 SG-1024/M-C Performance Data

3.1 Jetting Characteristics – SG-1024/M-C – Single Pulse

The performance curves shown for the SG-1024/M-C printhead were produced using waveform, part number 24368, is 7µs single pulse with a 30 V/µs slew rate. The printhead jetted Prova model fluid at 33° C and 8 kHz to achieve the 27 ng drop.

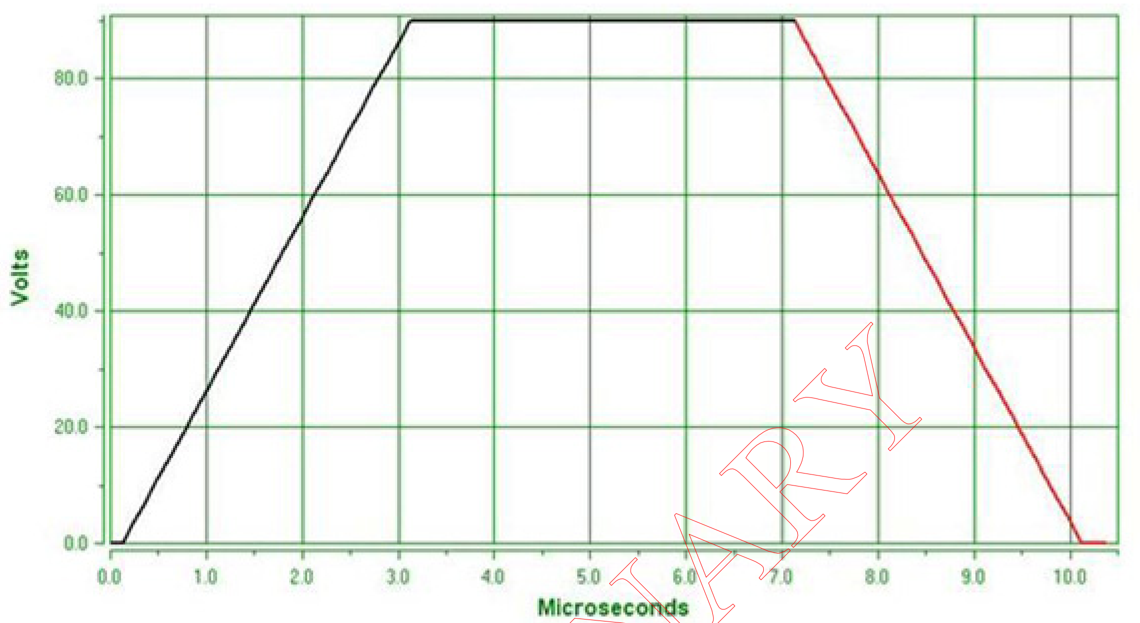


Figure C - 3 Single pulse waveform – part number 24368

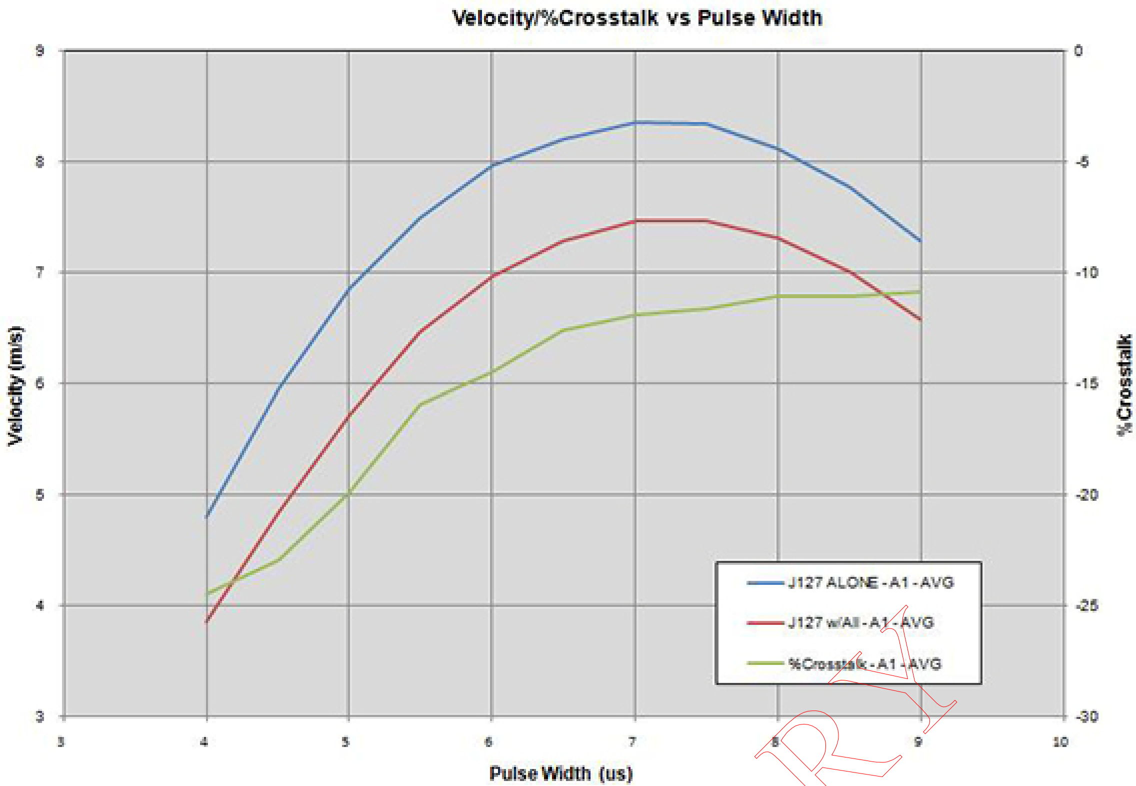


Figure C - 4 SG-1024/M-C Pulse Width vs. Velocity showing Percent Crosstalk

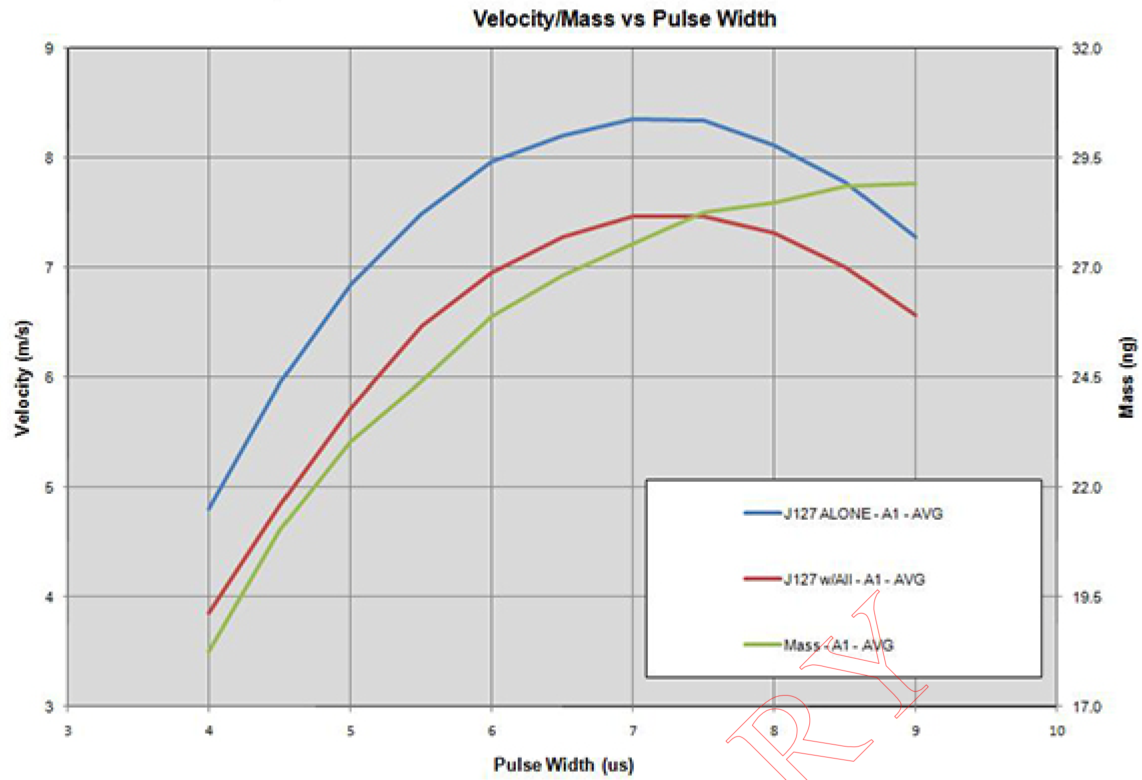


Figure C - 5 SG-1024/M-C Velocity and Mass vs Pulse Width

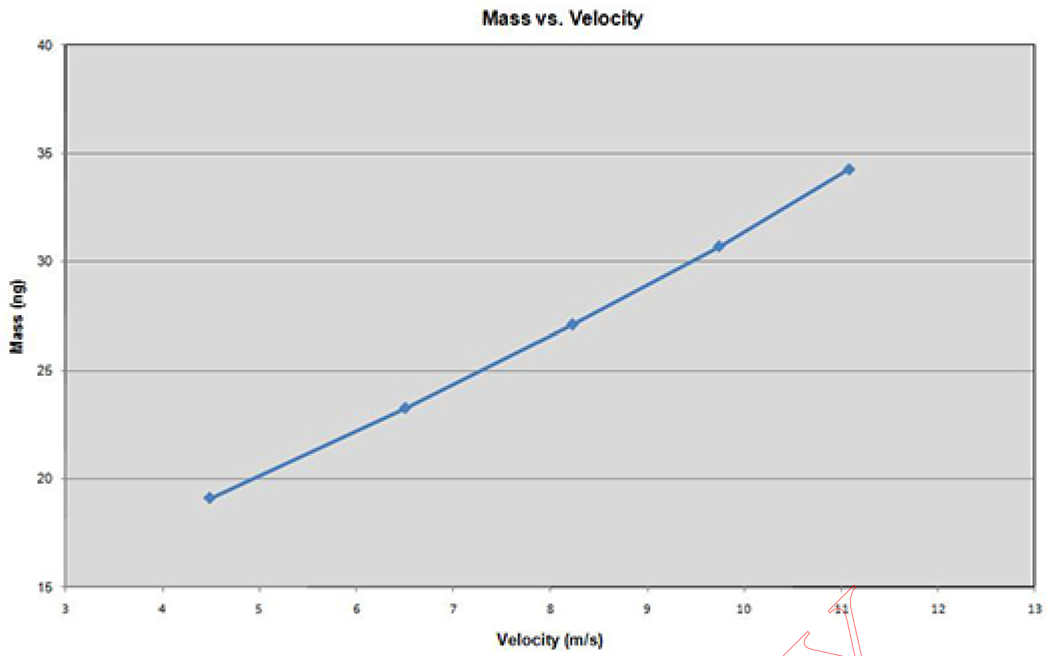


Figure C - 6 SG-1024/M-C Mass vs Velocity

Figure C - 7 SG-1024/M-C Velocity vs Voltage

Figure C - 8 SG-1024/M-C Mass vs Voltage

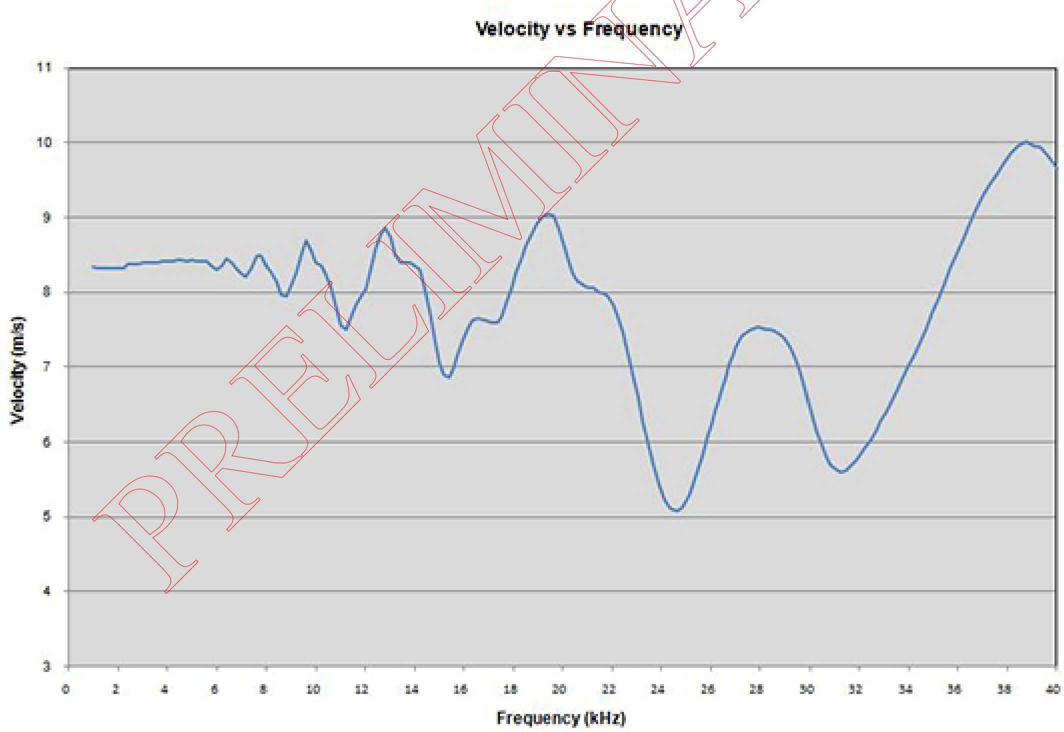


Figure C - 9 SG-1024/M-C Velocity vs Frequency

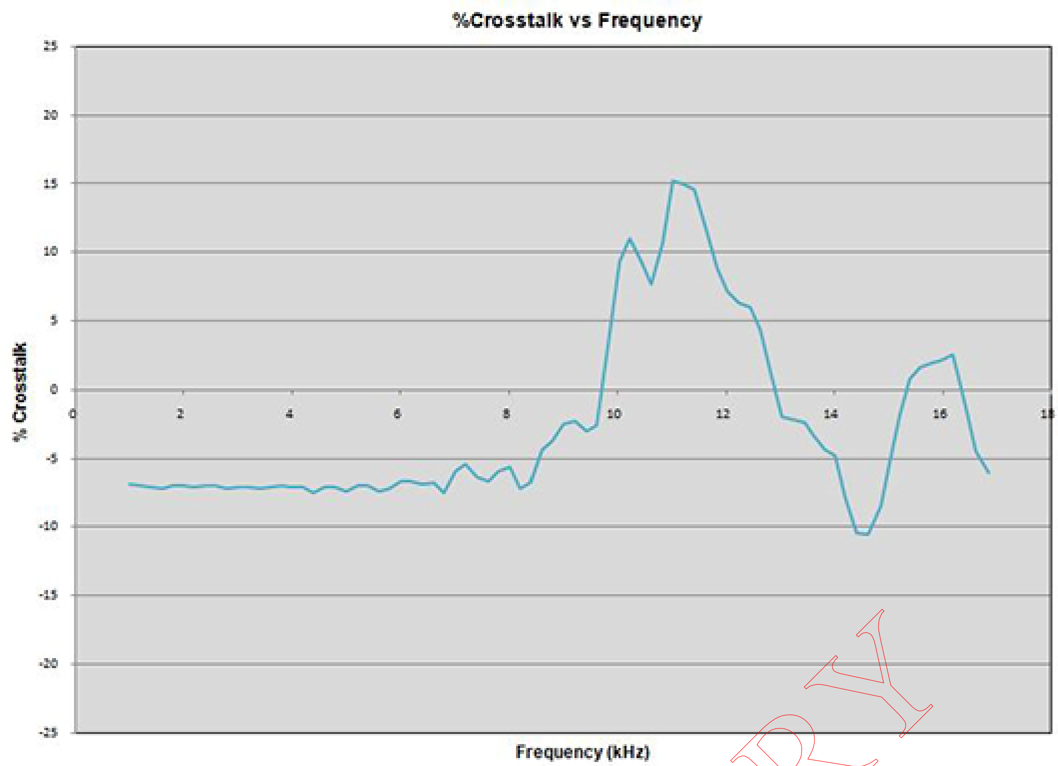


Figure C - 10 SG-1024/M-C %Crosstalk vs Frequency

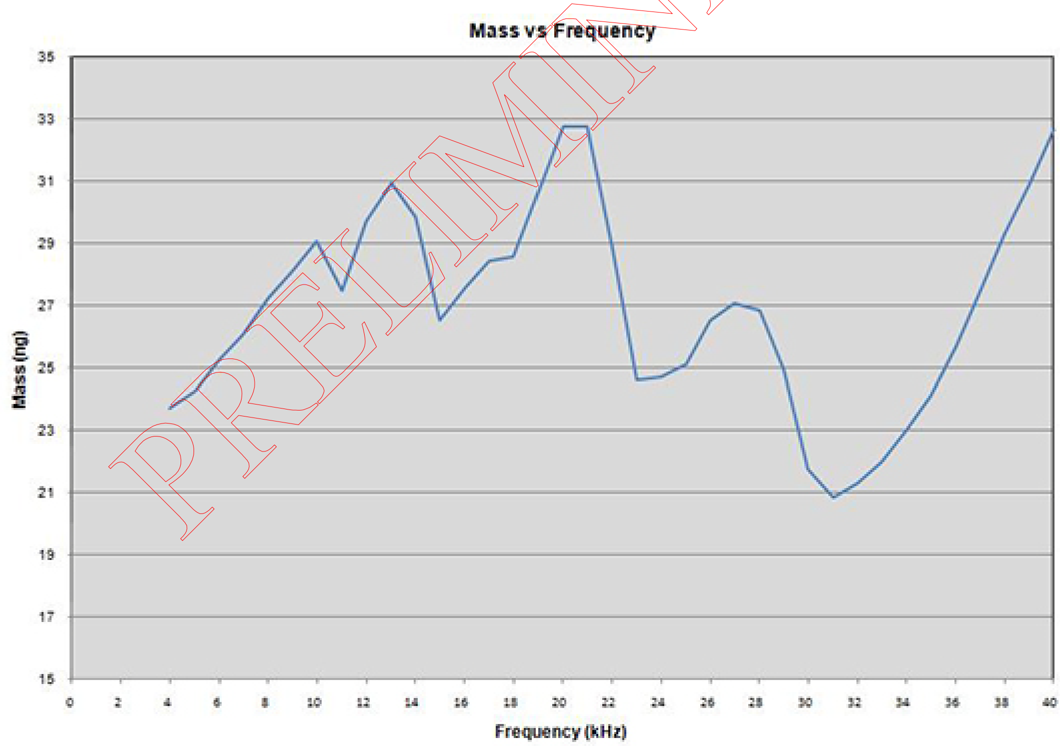


Figure C - 11 SG-1024/M-C Mass vs Frequency

3.2 Jetting Characteristics – SG-1024/M-C – Multi Pulse

The performance curves shown for the SG-1024/M-C printhead were produced using waveform, part number 24369, is a 3 pulse resonant waveform with 30 V/µs slew rates. The printhead jetted Prova model fluid at 33° C and 4 kHz to achieve the 65 ng drop.

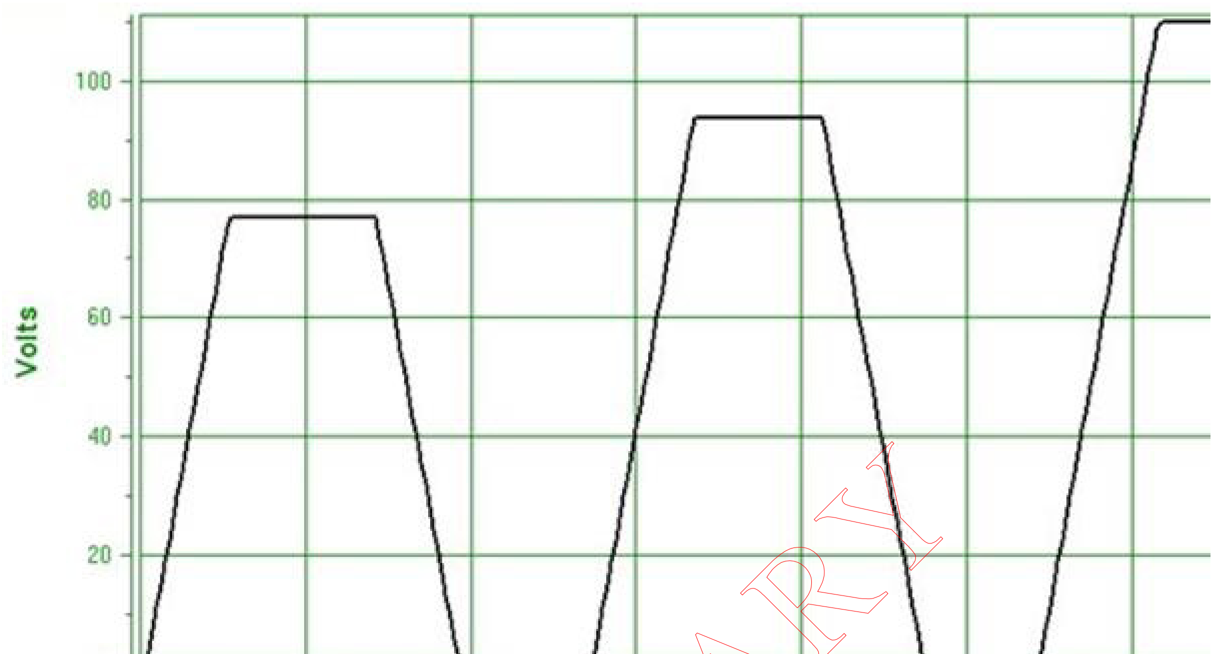


Figure C - 12 Multi pulse waveform – part number 24369

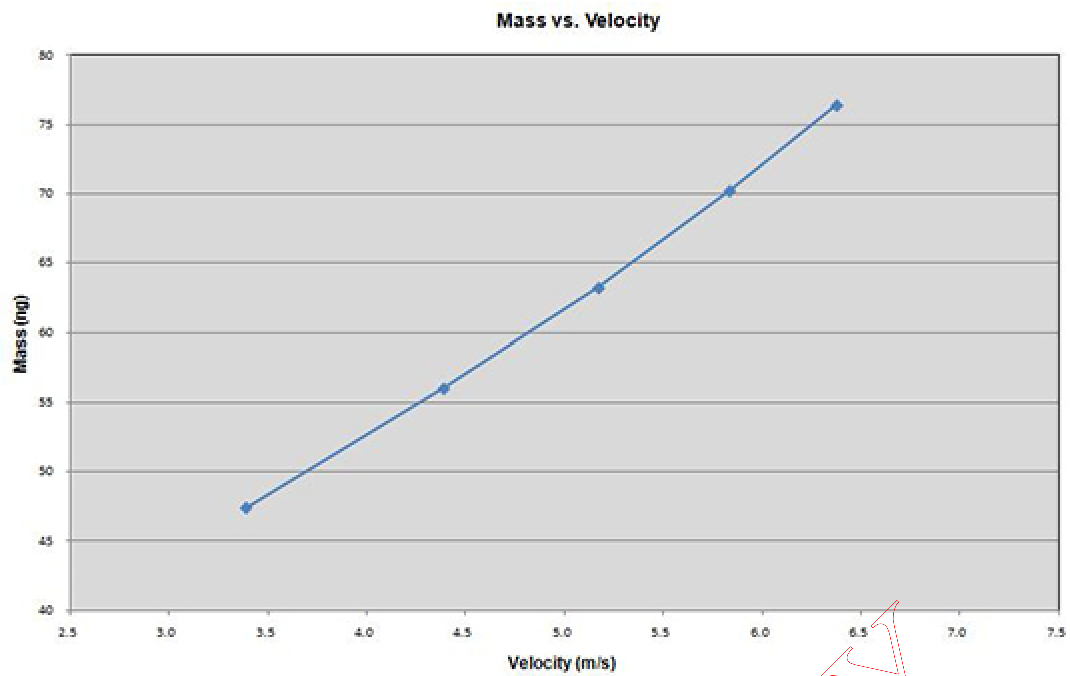


Figure C - 13 SG-1024/M-C Mass vs Velocity

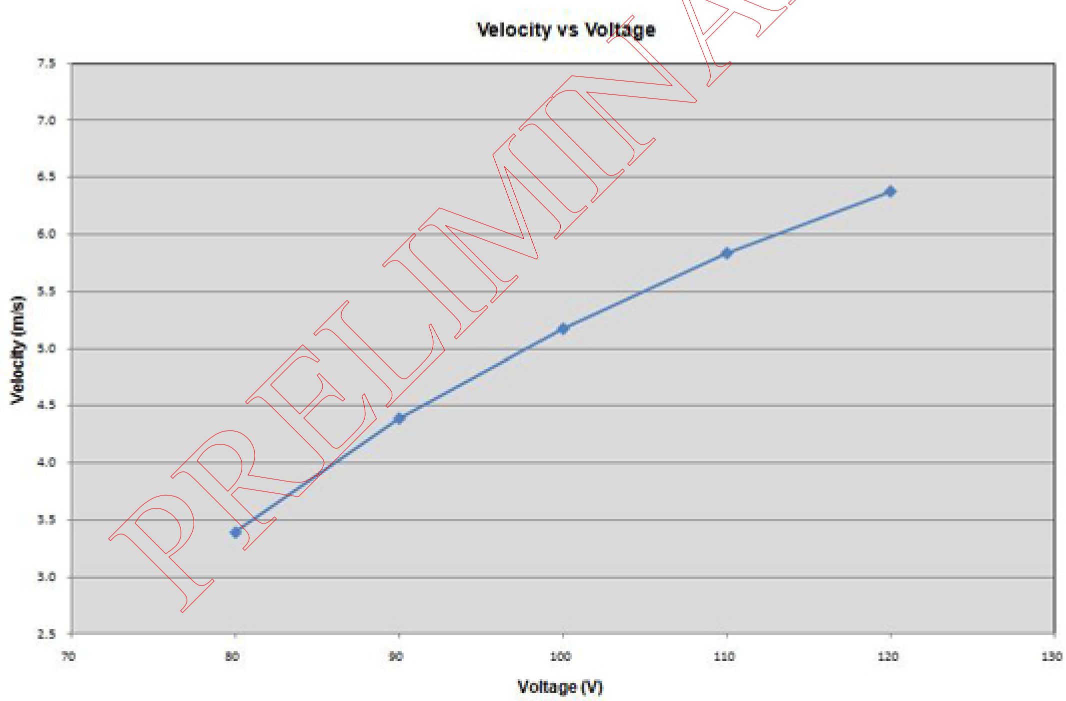


Figure C - 14 SG-1024/M-C Velocity vs Voltage

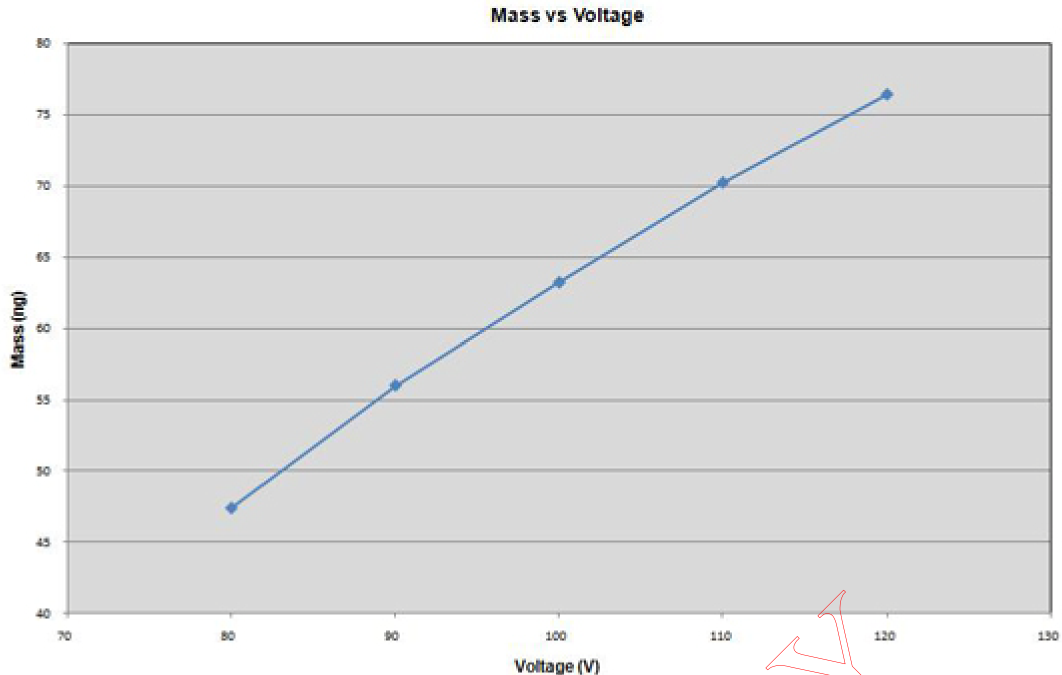


Figure C - 15 SG-1024/M-C Mass vs Voltage

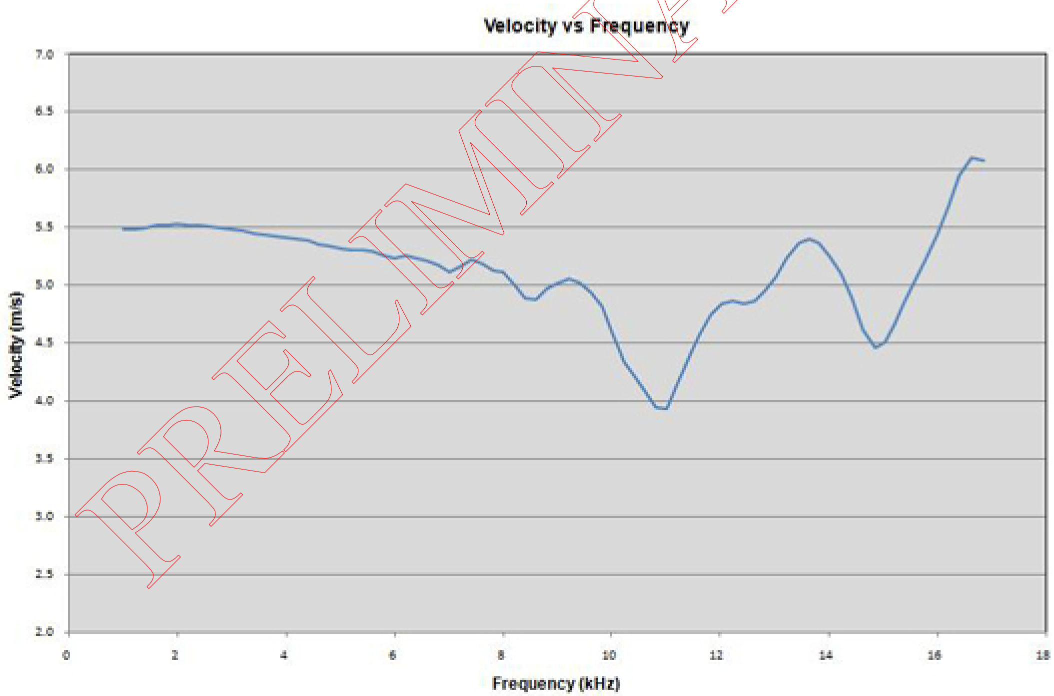


Figure C - 16 SG-1024/M-C Velocity vs Frequency

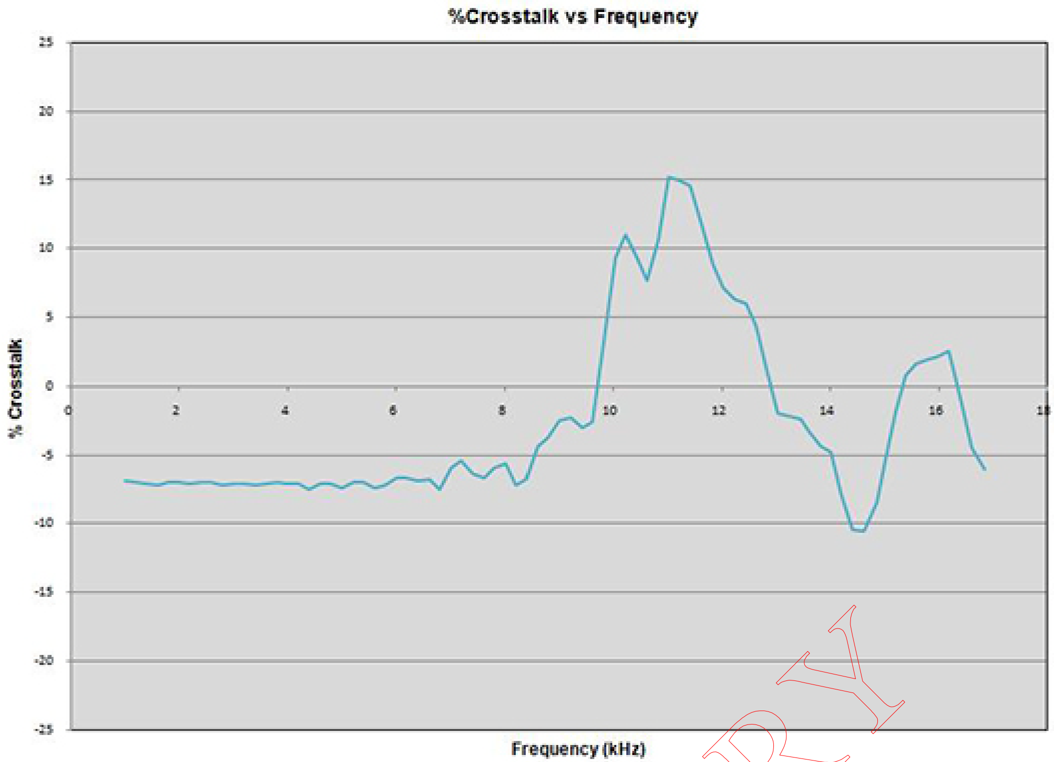


Figure C - 17 SG-1024/M-C %Crosstalk vs Frequency

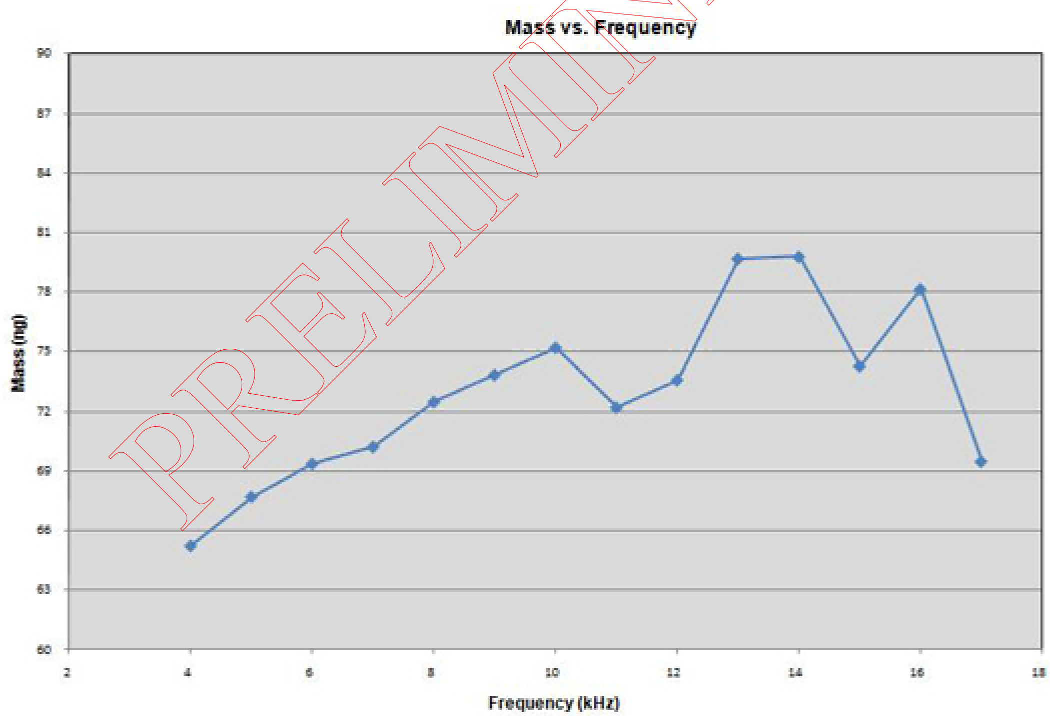


Figure C - 18 SG-1024/M-C Mass vs Frequency

Temperature – Resistance Thermistor Table for Murata NCP15XH103F03RC

Temperature (deg.C)	Resistance (k Ohm)	Temperature (deg.C)	Resistance (k Ohm)
0	27.218	26	9.634
1	26.076	27	9.283
2	24.987	28	8.947
3	23.950	29	8.624
4	22.962	30	8.314
5	22.021	31	8.018
6	21.123	32	7.733
7	20.266	33	7.460
8	19.449	34	7.199
9	18.669	35	6.947
10	17.925	36	6.706
11	17.213	37	6.475
12	16.534	38	6.252
13	15.885	39	6.039
14	15.265	40	5.833
15	14.673	41	5.635
16	14.107	42	5.445
17	13.566	43	5.262
18	13.048	44	5.086
19	12.554	45	4.916
20	12.080	46	4.753
21	11.628	47	4.597
22	11.194	48	4.446
23	10.779	49	4.300
24	10.381	50	4.160
25	10.000	51	4.026

Temperature (deg.C)	Resistance (k Ohm)	Temperature (deg.C)	Resistance (k Ohm)
52	3.896	89	1.302
53	3.771	90	1.268
54	3.651	91	1.234
55	3.535	92	1.201
56	3.423	93	1.170
57	3.315	94	1.139
58	3.211	95	1.109
59	3.111	96	1.080
60	3.014	97	1.052
61	2.922	98	1.025
62	2.833	99	0.999
63	2.748	100	0.973
64	2.665	101	0.949
65	2.586	102	0.925
66	2.509	103	0.902
67	2.435	104	0.879
68	2.363	105	0.858
69	2.294	106	0.836
70	2.227	107	0.816
71	2.162	108	0.796
72	2.100	109	0.776
73	2.039	110	0.7580
74	1.981	111	0.739
75	1.924	112	0.721
76	1.869	113	0.704
77	1.817	114	0.687
78	1.765	115	0.671
79	1.716	116	0.655
80	1.668	117	0.640
81	1.622	118	0.625
82	1.577	119	0.610
83	1.534	120	0.596
84	1.4927	121	0.582
85	1.4521	122	0.569
86	1.412	123	0.556
87	1.374	124	0.543
88	1.338	125	0.531

Product status and specifications are subject to change. Please confirm latest data with a Dimatix representative.

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