Xerox’s High Temperature, Increased Fluid Latitude, High Performance Print Head

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and OEM Print Head Project Manager
Xerox
Introduction: The M-Series Print Head

- Xerox has developed an industrial piezo ink jet print head that is ideal for high demand applications.

- This print head jets fluids ranging in temperature from ambient to 140 C.

- This print head jets water based, UV based, wax based, solvent based and even acids.

- This print head jets on a linear inch more fluid than any head on the market today.
M-Series
Print Head Design
## Key Parameters of the M-Series Head

<table>
<thead>
<tr>
<th>Operating Parameters</th>
<th>Unit of Measure</th>
<th>Xerox M-Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of addressable jets</td>
<td></td>
<td>880</td>
</tr>
<tr>
<td>4 Color (closest) nozzle spacing</td>
<td>microns (dpi)</td>
<td>337.5 (75)</td>
</tr>
<tr>
<td>Single color nozzle spacing</td>
<td>microns (dpi)</td>
<td>84.4 (300)</td>
</tr>
<tr>
<td>Rows of nozzles</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>Drop size</td>
<td>picoliters</td>
<td>17 to 30</td>
</tr>
<tr>
<td>Nominal drop velocity</td>
<td>m/s</td>
<td>up to 10</td>
</tr>
<tr>
<td>Operating temperature max</td>
<td>°C</td>
<td>140</td>
</tr>
<tr>
<td>Fluid viscosity</td>
<td>cP</td>
<td>6 to 11</td>
</tr>
<tr>
<td>Maximum operating frequency</td>
<td>kHz</td>
<td>43 kHz</td>
</tr>
</tbody>
</table>
The M-Series Print Head

Key Design Features

- Stainless steel jet stack (16 plates)
- Brazed Construction
- Teflon anti-wetting coating on face
Front and Back Pictures of the Head

Front View
- Wave Form Connector
- Data Cable Connector
- Main Driver Board
- Nozzle Array
- Jet Stack
- Slave Driver Board

Dimensions:
- 102 mm
- 89 mm
- 38 mm
- 48 mm

Back View
- Heater Cables
- Ink Feed Ports
- Thermistor
- PZT’s
- Ink Feed Ports
- Flex Cable

Heater Cables
- Wave Form Connector
- Main Driver Board
- Nozzle Array
- Jet Stack
- Slave Driver Board

Dimensions:
- 102 mm
- 89 mm
- 38 mm
- 48 mm
Aperture Layout

Mono

4-Color

Aperture Plate

Media Direction
Single Jet

**Key Single Jet Features**

- Bending Mode PZT Driver
- 40 micron aperture
- Inlet sized to acts as an inductive valve
- Body sized to allow for high packing density
- Outlet length determined by manifold size

Diagram showing the parts of a Single Jet:
- Aperture
- Outlet
- Inlet
- Body
- PZT
Manifold Construction

Purge Vent

Repeating Structure

Single Jet

Finger Manifold

Main Manifold

Note: Compliant wall on top of Main Manifold and Finger Manifold
Manifold Construction
(Allows 8 Different Fluids)
Key Design Attributes of the M-Series Head

- Stainless Steel Construction
- No adhesives (brazed jet stack)
- Teflon anti-wetting coating on face of jet stack
- Heated Jet stack with thermistor control to +/-1°C
- Designed for ability to purge
- Allows for 8 different fluids in one head
M-Series
Print Head
Performance
Waveform and Drop Ejection

- Wax based ink jetting at 5 m/s
- Aqueous ink jetting at 10 m/s

Adjustable waveform allows for tuning head to many different fluids while maximizing performance.
Head Calibration

- Coarse calibration by adjusting user defined waveform.
- Fine Jet to Jet calibration allowed by design of custom ASCI’s.
- Calibration values are digitally loaded.
- There are 64 levels for fine jet to jet calibration. Levels are user definable.
Head Calibration

- Corse calibration by adjusting user defined waveform.
- Fine Jet to Jet calibration allowed by design of custom ASCI’s.
- Calibration values are digitally loaded.
- There are 64 level for fine jet to jet calibration. Levels are user definable.
Key Reliability Attributes

- PZT driver tested to over 150 Billion actuation cycles (and still testing).
- Print heads tested to 10,000 Thermal Cycles.
- Print head failures intrinsically found to be 99.8% reliable on an overall head biases.
- Inside the stainless steel stack is an internal 33 micron filter.
Uses of Xerox Print Heads
Current Xerox Uses of the M-Series Print Head

Colorqube 9301
50ppm
Workgroup Office Printer

CiPress500
1000 ppm
Digital Press
Current OEM Uses of the Head/Technology

Printing etch masks on solar cells

Printing on pre-cut eyeglass lens.

Printing 3D parts
(Printed with a Xerox T-Series print head)
The Future
# Xerox OEM Print Heads

<table>
<thead>
<tr>
<th>Product Family</th>
<th>Type</th>
<th>Performance</th>
<th>Estimated Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>T-Series</strong></td>
<td></td>
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</tr>
<tr>
<td>1236 Jet, 8 inch, stainless steel</td>
<td>4 channel</td>
<td>41 kHz, 17 – 30 pl, 6 -11 cp</td>
<td>Commercial</td>
</tr>
<tr>
<td></td>
<td>2 channel</td>
<td>41 kHz, 17 – 30 pl, 6 -11 cp</td>
<td>Prototypes Available</td>
</tr>
<tr>
<td><strong>M-Series, Standard</strong></td>
<td>1, 4 or 8 channel</td>
<td>43 kHz, 17 – 30 pl, 6 -11 cp</td>
<td>Commercial</td>
</tr>
<tr>
<td>880 Jets, 3 inch all stainless steel</td>
<td>1, 4 or 8 channel, high viscosity</td>
<td>~43 kHz, 17 – 30 pl, 11-20 cp</td>
<td>Under Development</td>
</tr>
<tr>
<td><strong>M-Series Small Drop</strong></td>
<td>1, 4 or 8 channel</td>
<td>~80 kHz, 3 – 17 pl, 3 -11 cp</td>
<td>Call Xerox for Prototype Availability</td>
</tr>
<tr>
<td>880 Jets, 3 inch, stainless steel &amp; polyimide aperture</td>
<td>1, 4 or 8 channel, high viscosity</td>
<td>~80 kHz, 3 – 17 pl, 11-20 cp</td>
<td></td>
</tr>
<tr>
<td><strong>M-Serie Recirculation</strong></td>
<td>1 or 4 channel</td>
<td>~60 kHz, 10-20 pl, 6 -11 cp</td>
<td></td>
</tr>
<tr>
<td>880 Jets, 3 inch, stainless steel</td>
<td>1 or 4 channel, high viscosity</td>
<td>~60 kHz, 10-20 pl, 11-20 cp</td>
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