XAAR 1201 GS2p5 Printhead

MEMS PZT Inkjet Die

MEMS report by Sylvain Hallereau
September 2018 – Sample
## Table of Contents

**Overview / Introduction**  3  
- Executive Summary
- Reverse Costing Methodology

**Company Profile**  7  
- Xaar
- Ricoh

**Physical Analysis**  15  
- Synthesis of the Physical Analysis
- Physical Analysis Methodology
- Print Head  
  - Print head Views & Dimensions
  - Print Head Disassembly
  - Print Head Cross-Section
- Flex
- Driver IC
- Inkjet Die Disassembly  
  - Nozzles
  - Nozzles and inlet and Outlet
  - Disassembly
  - Pressure Chambers
  - Cross-Section
  - PZT Actuator
- Comparison

**Sensor Manufacturing Process**  93  
- Driver IC
- 1201 Inkjet Die
- 1201 Printhead

**Cost Analysis**  114  
- Accessing the BOM
- Driver Wafer and Die Cost
- MEMS Inkjet Die  
  - Pressure Chamber Cost
  - Inlet Substrate Cost
  - Inkjet Substrate Cost
  - Final Assembly cost
  - Component Cost
- BOM Cost
- Material Cost Breakdown by Component Category
- Accessing the Added Value (AV) cost
- Details of the Electronic Board AV Cost
- Details of the Housing AV Cost
- Manufacturing Cost Breakdown for 50K units

**Estimated Price Analysis**  142  
- Estimation of the Manufacturing Price

**Customer Feedback**

**Company services**
Executive Summary

This full reverse costing study has been conducted to provide insight on technology data, manufacturing cost and selling price of the PZT Print head and of the PZT Inkjet Die used in the Xaar.

The PZT printhead integrates 1 inkjet chip.

We have simulated the cost of the 1201 print head for a volume of 50,000 units in 2018.

The total material and manufacturing costs calculated in this report reflect only the costs for direct materials, manufacturing and basic tests. Not included in this analysis are the costs of intellectual property, royalties and licensing fees, software loading and test, shipping, logistics, marketing.

The Xaar PZT Inkjet Die is a inkjet die manufactured for professional applications.
Executive Summary

The MEMS inkjet printhead market is expected to reach $1B in 2023, with a 3.5% compound annual growth rate (CAGR) from 2017 to 2023. With that, office printers and industrial segments are driving innovative technologies for piezo printheads, with CAGRs of 2.7% and 18% respectively for the next five years.

System Plus Consulting has a long experience on reverse costing studies on printhead with more than 15 custom analysis. Today our competency in the reverse costing of printheads is disponible in catalog report and we are proud to release two catalogue reports on Epson and Xaar printhead.

1201 printhead is the first MEMS inkjet die from XAAR for the industrial printer. The printhead integrate a large MEMS die of more 400mm². Each printhead can print 1, 2 or 4 colors thanks at their 1280 nozzles. The density go to 300dpi for 4 colors at 600dpi for 2 colors.

This reverse costing study provides insight into technological data, manufacturing cost, and selling price of the inkjet MEMS manufactured by Ricoh and the 1201 printhead supplied by XAAR.

The inkjet MEMS used 2 silicon substrates to manufacture the inlet and the pressure chamber. The nozzles are not manufactured in silicon but still in steel. The membrane of the pressure chamber is a very complex multilayer structure. The PZT thin film actuator manufactured above with the two electrodes show a complex structure in the material choice and in the stacking structure. An exclusive deposition technology developed by Ricoh allows an important reduction of the consumption of the very expensive sol-gel PZT.

The MEMS inkjet die has 4 rows of nozzles interleaved on the die. The MEMS is assembled in the 1201 printhead with a flex to connect the MEMS to the printer. The 4 driver ICs are directly assembled on the MEMS die.

A comparison between the XAAR 1201 and the Epson PrecisionCore printhead is included.
1201 Printhead Disassembly
Printhead X-Ray
Printhead Cross-Section

Print head cross-section – optical view
©2018 by System Plus Consulting
Inkjet Die Cross-Section

©2018 by System Plus Consulting

Detail Inkjet Die Cross-Section –SEM View
©2018 by System Plus Consulting
PZT Actuator

Overview / Introduction

Company Profile & Supply Chain

Physical Analysis
- 1201 Printhead
- Flex
- Driver IC
- Inkjet Die
- Comparison

Manufacturing Process Flow

Cost Analysis

Selling Price Analysis

Related Reports

About System Plus
Pressure Chamber Substrate - MEMS Process

Overview / Introduction

Company Profile & Supply Chain

Physical Analysis

Manufacturing Process Flow
- Global Overview
- Driver IC
- Inkjet Die
  - Process Flow
- Global Structure
- Printhead

Cost Analysis

Selling Price Analysis

Related Reports

About System Plus
Inlet Substrate – MEMS Front-End Cost

Cost Analysis
- Global Overview
- Driver IC
- MEMS Inkjet Die
  - Pressure Chamber
  - Inlet Substrate
- Inkjet Substrate
- Inkjet Die Cost
- Printhead

Selling Price Analysis

Related Reports

About System Plus
### Manufacturing Cost Breakdown for 50K units in 2018

<table>
<thead>
<tr>
<th>Article</th>
<th>Qty</th>
<th>Added Value</th>
<th>Manufacturing Duration (%)</th>
<th>Material Cost</th>
<th>Manufacturing Cost without scrap &amp; supplying costs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>18H421 - XAAR 1201 printhead</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XAAR 1201 printhead</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inkjet Flex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>18H421 - XAAR 1201 printhead</th>
<th>ASSEMBLY COST</th>
<th>MATERIAL COST</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>XAAR 1201 printhead</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inkjet Flex</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Related Reports

**REVERSE COSTING ANALYSES - SYSTEM PLUS CONSULTING**

**MEMS**
- Epson PrecisionCore Printhead with MicroTFP Inkjet Dies
- MEMS Pressure Sensor Comparison 2018
- Vesper VM1000 Piezoelectric Microphone

**MARKET AND TECHNOLOGY REPORTS - YOLE DÉVELOPPEMENT**

**MEMS**
- Inkjet Functional and Additive Manufacturing for Electronics
MEMS inkjet printheads are benefiting from growing interest in industrial printing for textiles, labels or decoration. A huge compound annual growth rate (CAGR) of 18% for the next five years is expected for commercial and industrial MEMS printheads, reaching more than $200M revenue in 2023.

System Plus Consulting has long experience in printhead reverse costing studies, with more than 15 custom analyses. Today we are using our competency to simultaneously release two reports on Epson and Xaar printheads.

The 1201 printhead is the first MEMS inkjet die from Xaar for industrial printers. The printhead integrates a large MEMS die, with area exceeding 400mm². Each printhead can print one, two or four colors thanks to their 1280 nozzles. The density is therefore 300dpi for four colors and 600dpi for two colors.

This reverse costing study provides insight into technological data, manufacturing cost, and selling price of the MEMS inkjet manufactured by Ricoh and the 1201 printhead supplied by Xaar.

The MEMS inkjet uses two silicon substrates to manufacture the inlet and the pressure chamber. The nozzles are still manufactured in steel.

The membrane of the pressure chamber is a very complex multilayer structure. The lead zirconate titanate (PZT) thin film actuator is manufactured above this, with its two electrodes showing complexity in material choice and in stacking structure. Significantly, exclusive deposition technology developed by Ricoh uses less of the very expensive sol-gel PZT.

The MEMS inkjet die has four rows of nozzles interleaved on the die. The MEMS dies are assembled in the 1201 printhead with a flex to connect the MEMS to the printer. The four driver integrated circuits are directly assembled on the MEMS die.

This report includes a comparison between the Xaar 1201 and the Epson PrecisionCore printhead.
TABLE OF CONTENTS

Overview/Introduction
- Executive Summary
- Reverse Costing Methodology

Company Profile
- Xaar
- Ricoh

Physical Analysis
- Printer Disassembly
  - Print head views and dimensions
  - Print head disassembly and cross-section
- Printhead
  - Flex
- Driver IC
  - Die dimension
  - Transistor
  - CMOS process
- Inkjet Die
  - Nozzles
  - Nozzles and inlet and outlet
  - Disassembly
  - Pressure chambers
  - Cross-section
  - PZT actuator
- Comparison

Manufacturing Process
- Driver IC
- 1201 Inkjet Die and Printhead

Cost Analysis
- Accessing the BOM
- Driver Wafer and Die Cost
  - Driver wafer and die cost
  - Nozzle plate cost
  - Flow path substrate cost
  - Vibration plate cost
  - Protection substrate cost
  - Final assembly cost
  - Component cost sensor die
- BOM Cost
- Material Cost Breakdown by Component Category
- Accessing the Added Value (AV) Cost
- Details of the Electronic Board AV Cost and the Housing AV Cost
- Manufacturing Cost Breakdown for 3M units

Selling Price

AUTHORS

Sylvain Hallereau is in charge of costing analyses for IC, power and MEMS. He has more than 10 years of experience in power device manufacturing cost analysis and has studied a wide range of technologies.

Yvon Le Goff has joined System Plus Consulting in 2011, in order to setup the laboratory of System Plus Consulting. He previously worked during 25 years in Atmel Nantes Technological Analysis Laboratory as fab support in physical analysis, and 3 years at Hirex Engineering in Toulouse, in a DPA lab.

RELATED REPORTS

Epson PrecisionCore Printhead with MicroTFP Inkjet Dies
For the first time, Epson integrates thin film PZT MEMS into its office inkjet printer.
September 2018 - Price: EUR 3,990*

MEMS Pressure Sensor Comparison 2018
Structure and costing comparison of 34 MEMS pressure sensors from 18 different manufacturers in consumer, automotive and industrial applications.
May 2018 - EUR 4,990*

Vesper VM1000 Piezoelectric Microphone
First piezoelectric MEMS microphone could disrupt consumer applications.
February 2017 - EUR 3,490*
Our analysis is performed with our costing tools MEMS CoSim+ and SYSCost+.
System Plus Consulting offers powerful costing tools to evaluate the production cost and selling price from single chip to complex structures.

**SYSCost+**
Provides all component costs estimation including PCB, housing and connectors, and a simulation of the assembly cost and test process at the board and system level.

**MEMS CoSim+**
Cost simulation tool to evaluate the cost of any MEMS process or device.

**WHAT IS A REVERSE COSTING®?**
Reverse Costing® is the process of disassembling a device (or a system) in order to identify its technology and calculate its manufacturing cost, using in-house models and tools.

**CONTACTS**

**Headquarters**
22, bd Benoni Goullin
Nantes Biotech
44200 Nantes
France
+33 2 40 18 09 16
sales@systemplus.fr

**America Sales Office**
Steve LAFERRIERE
Western USA
+1 310-600-8267
laferriere@yole.fr

Troy BLANCHETTE
Eastern USA
+1 704-859-0453
troy.blanchette@yole.fr

**Asia Sales Office**
Takashi ONOZAWA
Japan & Rest of Asia
+81 3 4405 9204
onozawa@yole.fr

Mavis WANG
Greater China
+86 979 336 809
wang@yole.fr

**Europe Sales Office**
Lizzie LEVENEZ
Frankfurt am Main
Germany
+49 151 23 54 41 82
llevenez@systemplus.fr

System Plus Consulting is specialized in the cost analysis of electronics from semiconductor devices to electronic systems.
A complete range of services and costing tools to provide in-depth production cost studies and to estimate the objective selling price of a product is available.

**Our services:**
- **STRUCTURE & PROCESS ANALYSES**
- **CUSTOM ANALYSES**
- **COSTING SERVICES**
- **COSTING TOOLS**
- **TRAININGS**

www.systemplus.fr
sales@systemplus.fr
Please process my order for “Xaar 1201 GS2p5 PZT Printhead” Reverse Costing® – Structure, Process & Cost Report
Ref: SP18421

- Full Structure, Process & Cost Report: EUR 3,990*
- Bundle Offer with Epson PrecisionCore Printhead with MicroTFP Inkjet Dies
- Annual Subscription offers possible from 3 reports, including this report as the first of the year. Contact us for more information.

ORDER FORM

SHIP TO
Name (Mr/Ms/Dr/Pr): .............................................................
Job Title: .............................................................................
Company: ............................................................................
Address: .............................................................................
City: ........................................................ State: ......................
Postcode/Zip: .............................................................
Country: .............................................................................
VAT ID Number for EU members: .....................................
Tel: .....................................................................................
Email: ................................................................................
Date: ..................................................................................
Signature: .........................................................................

BILLING CONTACT
First Name: ...........................................................................
Last Name: ...........................................................................
Email: ................................................................................
Phone: ..............................................................................

PAYMENT
By credit card:
Number: |__|__|__|__|  |__|__|__|__|  |__|__|__|__|
|__|__|__|__|
Expiration date: |__|__|/|__|__|
Card Verification Value: |__|__|__|

By bank transfer:
HSBC, 1 place de la Bourse, F-69002 Lyon, France
SWIFT or BIC code: CCFRFRPP
Bank code : 30056 - Branch code : 00170 - Account : 0170200156587
IBAN: FR76 3005 6001 7001 7020 0156 587

*For price in dollars please use the day’s exchange rate
*All reports are delivered electronically in pdf format
*For French customer, add 20 % for VAT
*Our prices are subject to change. Please check our new releases and price changes on www.i-micronews.com. The present document is valid 6 months after its publishing date: September 2018

ANNUAL SUBSCRIPTIONS
Each year System Plus Consulting releases a comprehensive collection of new reverse engineering and costing analyses in various domains. You can choose to buy over 12 months a set of 3, 4, 5, 7, 10 or 15 Reverse Costing® reports.

Up to 47% discount!

More than 60 reports released each year on the following topics (considered for 2018):
- Power: GaN - IGBT - MOSFET - Si Diode - SiC
- Imaging: Camera - Spectrometer
- LED and Laser: UV LED – VCSEL - White/blue LED
- Packaging: 3D Packaging - Embedded - SIP - WLP
- Integrated Circuits: IPD – Memories – PMIC - SoC
- RF: FEM - Duplexer
- Systems: Automotive - Consumer - Energy - Telecom
Business Models Fields of Expertise

- Custom Analyses
  (>130 analyses per year)

- Reports
  (>40 reports per year)

- Costing Tools

- Trainings
  SAMPLE

- Display
- LED
- IC & RF
- MEMS & Sensors
- PCB
- Imaging
- Packaging
- Systems
- Power

About System Plus
- Company services
  - Contact
  - Legal