

Smart Servicing Solutions of HP 108mm Printheads

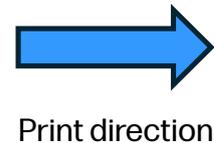
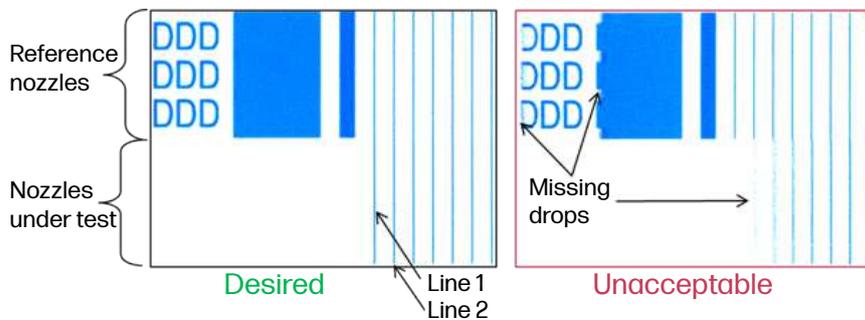
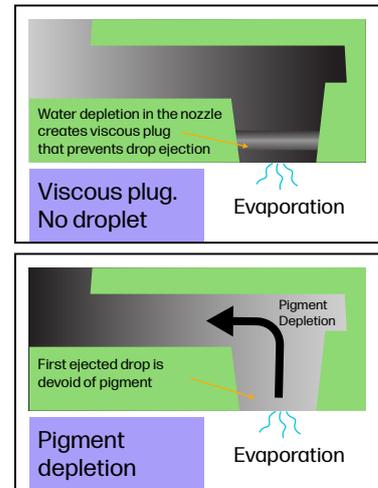


HP's patented micro-recirculation technology

This paper introduces HP's Smart Servicing Solution for the HP108 mm Printheads, explains what it is, what problems it solves, its advantages and benefits and how it differs from competitive offerings.

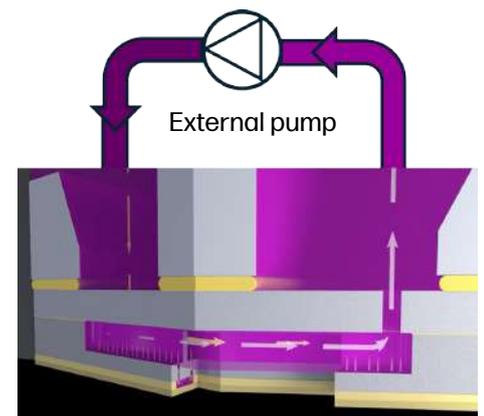
Missing drops from idle nozzles

Inkjet printing involves ejecting ink droplets from thousands of nozzles to form an image. When a nozzle is not printing, water or solvent still evaporates from the orifice because of a temperature difference between the printhead and the ambient environment. If evaporation continues for more than a few seconds, pigment particles and other solids dissolved in the ink begin to accumulate in the nozzle, eventually forming a gooey film. The film may impede the ejection of the next droplet when printing resumes. In other inks, evaporation breaks the chemical balance in the nozzle and causes pigment depletion. Both effects result in printing defects. Typically, several drops need to be ejected from the idle nozzle before print quality returns to normal.



Ink recirculation

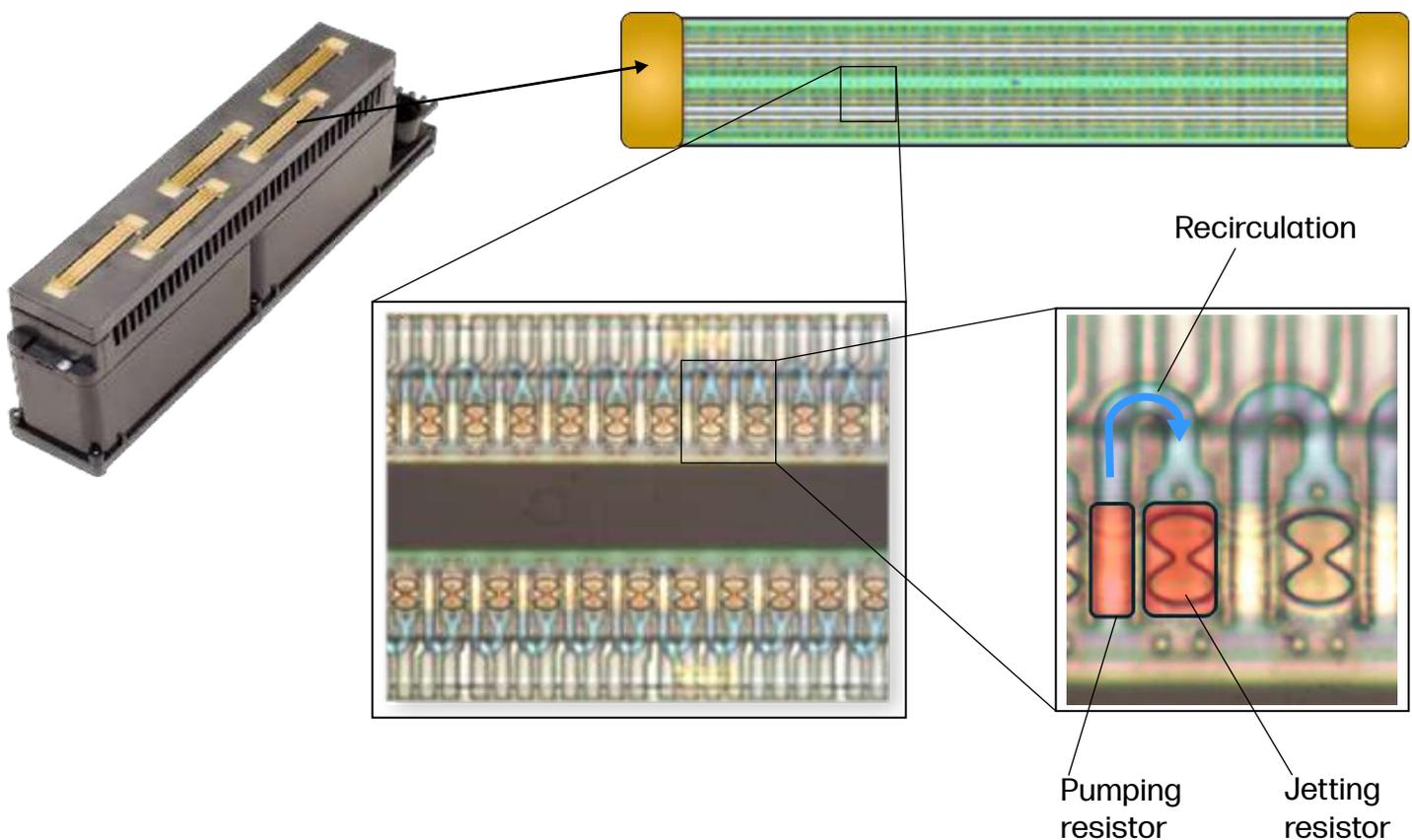
Ink recirculation is an effective method for mitigating solvent evaporation without the need for waste jetting. Instead, ink continuously flows past the nozzle in a circular fashion, drawing from and returning to the bulk of ink supply. This process ensures that ink near the nozzle is always fresh, well-mixed, and ready to be jetted, even if the nozzle has not been firing for seconds or even minutes. The method is similar to manual mixing of household latex paint before painting a wall. In most printheads, ink recirculation is achieved by an external pump inline with the ink supply. The pump is macroscopic and serves all nozzles at the same time. Flow rate control at the individual nozzle level is not possible.



HP's Smart Servicing Solutions

HP 108mm Printhead utilizes an integrated version of recirculation technology. Instead of relying on a large external pump, each nozzle is equipped with its own dedicated micropump. Ink channels are arranged in tiny U-shaped loops, all connected to a shared macroscopic ink reservoir. One side of the loop contains a thermal resistor with a nozzle above it; firing this resistor ejects a droplet of ink toward the substrate. Another side of the loop has a similar resistor but without a nozzle. Firing this resistor does not eject a droplet but instead creates a circular flow of ink through the U-shaped channel, turning the resistor into a tiny pump. Although the physics behind the pump operation is complex, it is entirely deterministic and well-understood (*see Technical References). These pumps do not have any moving parts and function reliably for hundreds of billions of firings.

The net result is a continuous flow of fresh ink past every nozzle, ensuring that all nozzles are always ready to print, regardless of their firing history. Printed images appear without defects, even if the printhead remains idle for minutes or hours. Flow rates are controlled by electrical signals and can be adjusted to be the same or different for individual nozzles or nozzle groups, depending on the application's requirement. HP refers to this feature as "Smart Servicing Solution".



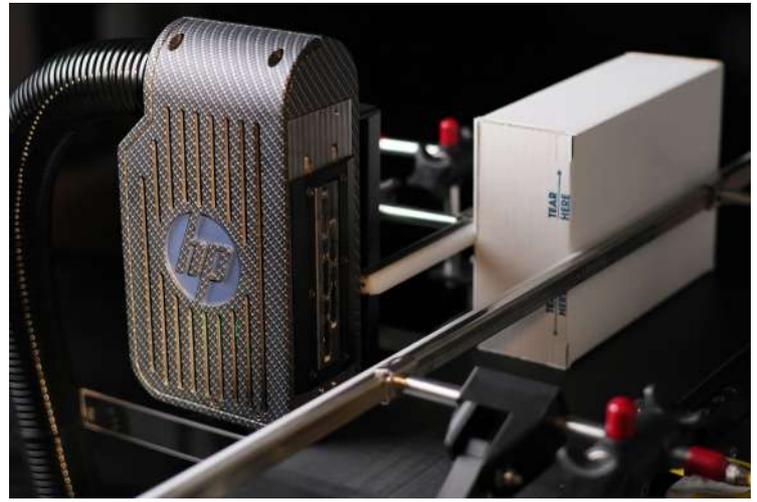
Always ready to print

HP's Smart Servicing Solution does not require external pumps. The system contains no moving parts and is therefore simpler and more reliable overall. Smart Servicing Solution protocols can be embedded in firmware and remain virtually invisible to the user or integrator. It is facilitated by the small size and high density of thermal resistors. In piezo printheads, nozzle volumes are much larger, and equipping each nozzle with its own individual pump is not practical.

As a result, HP 108mm Printhead is always ready to print. Even if left idle for a long time, it produces accurate images in both orientations.



Vertical printing



Horizontal printing

CARL VINSON
2025550186
HP INC.
16399 W BERNARDO DR
SAN DIEGO, CA 92127

4 LBS

1 OF 1

SHP#: X924 04PK
PIP
SHP WT: 4 LBS
SHP DWT: 4 LBS
DATE: 19 JAN 2023

SHIP TO:
JOHN C. SENNIS
2025559784
1115 SE 164TH AVE
VANCOUVER WA 98683

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VANCOUVER WA 98683



WA 306 4-50



UPS PRIORITY OVERNIGHT

TRACKING #: 1Z 875 Y8Y 12 9004 9334



BILLING: P/P
DESC: PRODUCT

KEY



WA 306 4-50



UPS PRIORITY OVERNIGHT

TRACKING #: 1Z 875 Y8Y 12 9004 9334



BILLING: P/P
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KEY

Initial print

Print after the printhead was left open for 72 hours

*Technical references:

- Tornjainen et al, Bubble-driven inertial micropump. Physics of Fluids, 24, 122003 (2012).
- Govyadinov et al, Single-pulse dynamics and flow rates of inertial micropumps. Microfluid Nanofluid, 20, 73 (2016).
- Kornilovitch et al, Temperature dependence of inertial pumping in microchannels. Physics of Fluids, 34, 022003 (2022).
- Przybyla J and Govyadinov AN, Increased ink space with existing thermal inkjet silicon and printhead modules using micro pumping, NIP & Digital Fabrication Conference (2018), 131.

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