

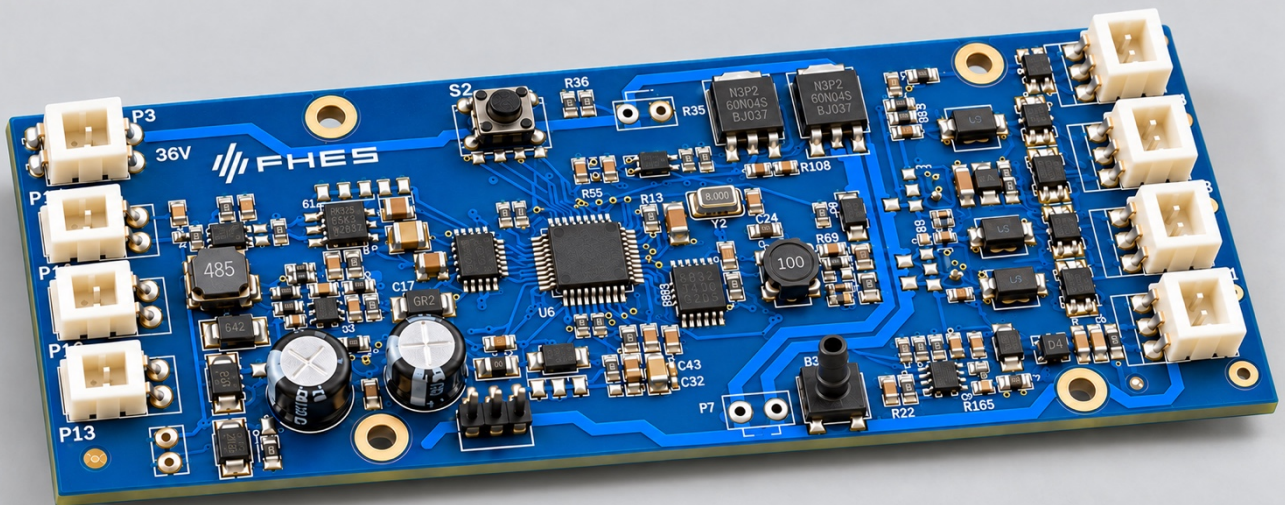
CIRCULATING INK CONTROL / PRODUCT GUIDE

CCS

Recirculating Ink Supply System

Internal printhead circulation · Integrated MCU control · Precise pressure differential and temperature control

Ink supply → Internal printhead circulation → Ink return



Continually refresh ink within the printhead flow path; the circulation route depends on the compatible printhead.

For white ink, highly pigmented ink and long continuous print runs

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Circulation reaches the printhead's internal flow path

CCS is FHES's integrated recirculating ink supply system, often called small-loop ink circulation.

CCS / Circulation Control System

Ink circulates through the internal flow path of a compatible printhead and returns to the system. The MCU coordinates circulation, supply and return pressures, ink level, solenoid valves and heating to maintain controlled ink renewal near the printhead.

A different circulation location from PCS

PCS Anti-Settling Circulation	Agitation in the primary tank and circulation in the secondary cartridge act mainly on the supply side.
CCS Small-Loop Circulation	Ink flows through the compatible printhead's internal circulation path to refresh ink near the nozzles.

Internal circulation paths, flow rates and ink exchange near the nozzles vary by printhead. Verify CCS results with the specific printhead and ink.

02 / Integrated control

One MCU coordinates circulation and ink-path status

One control system manages the circulation pump, negative pressure, solenoid valves, ink level, ink supply and heating.

01 / PUMP

Circulation-pump management

Control pump operation according to system status to keep ink moving.

02 / PRESSURE

Circulation negative pressure

Manage target pressure and feedback while coordinating ink supply and return.

03 / VALVE

Solenoid-valve control

Switch ink-path actions according to operating conditions.

04 / LEVEL

Ink-level management

Use ink-level information for supply control and fault prompts.

05 / SUPPLY

Ink-supply management

Control ink supply according to ink level and system status.

06 / HEAT

Heating management

Use PID temperature control to reduce heating overshoot.

Integrated control reduces adjustment across separate modules. Parameters, actions and faults can be checked through one system path.

03 / Pressure and temperature control

Two closed loops stabilize pressure and temperature

Separate PID loops control circulation pressure and heating to maintain ink operating conditions during long print runs.

$\pm 0.05 \text{ kPa}$

Circulation negative-pressure control accuracy

Control circulation-system pressure around its setpoint.

$\pm 0.5 \text{ }^{\circ}\text{C}$

Heating-temperature control accuracy

PID adjusts heater output to limit ink-path temperature overshoot.

Verify control targets alongside printed results

Pressure status	Check inlet and return pressures against the target negative pressure; observe startup and stabilization.
Temperature Status	Check how each heating zone reaches temperature and its fluctuations after stabilization.

Specification note

These are CCS performance values provided by FHES. Define the measurement points, ink, environment, stabilization time and statistical window in the acceptance criteria for the specific configuration.

04 / Internal printhead circulation

Keep highly pigmented ink moving

Continuous flow inside the printhead helps reduce white-ink settling, local clogging and trapped air bubbles.

The flow path through the printhead matters

Ink circulates through a compatible printhead to refresh its flow path. This reduces localized settling of heavy white pigments and may carry bubbles away from active flow paths.

01 / PIGMENT

Reduce settling risk

Continuous movement of highly pigmented ink reduces localized deposits.

02 / AIR

Carry away air bubbles

Circulation can carry bubbles out of the printhead flow path and reduce missing-jet risk.

03 / RESTART

Support restart

Maintaining suitable circulation after printing stops can shorten restart preparation.

04 / JETTING

Maintain jetting

Reduce stoppages caused by missing jets or changing nozzle condition.

These effects depend on the printhead flow path and circulation rate. They do not mean that every nozzle is maintenance-free or that every bubble can be removed automatically.

05 / Continuous operation

Designed for 24/7 production lines

Continuous circulation and stable pressure and temperature control support long runs, shift changes and intermittent production.

Less settling

Help keep white ink uniform

Fewer bubbles

Reduce the risk of missing jets

Stable operating conditions

Control temperature and negative pressure

Faster recovery

Shorten restart preparation

Checks during continuous operation

Start production.

Verify circulation, pressure, temperature and first-piece print quality.

Ongoing attention

Monitor nozzle condition, ink-system alarms and consistency during long runs.

24/7 operation is a design target for continuous production. Actual operation still requires checks and maintenance according to the ink and equipment requirements.

Support more demanding inks and longer throw distances

Circulation improves ink renewal. Usable viscosity and print distance still depend on the printhead, ink, waveform and workstation.

01 / WHITE

Highly pigmented white ink

Refresh the flow path continuously to reduce settling and nozzle-clogging risk from heavy pigments.

02 / VISCOSITY

Higher-viscosity fluids

With a compatible printhead and temperature control, expand the range of inks and liquids that can be evaluated.

Up to 50 mm

Long-throw printing application

CCS can provide a stable ink path for long-throw printers. Maximum print distance depends on the specified printhead, droplet, ink and site conditions.

Three priorities for sample validation

Ink viscosity and settling at operating temperature / Drop placement and clarity at the target throw distance / Nozzle condition and maintenance interval during long runs

Visible parameters support informed maintenance

Use circulation, pressure, temperature, ink level and supply status to assess and restore operation on site.

Startup Checks

Once circulation is established, verify target pressure, temperature and first-piece output.

Circulation Status

Observe pump and valve operation; confirm ink supply and return.

Ink Level and Supply

Use ink-level and supply status to manage refilling and faults.

Temperature Tracking

Check PID heating and stable temperature zones.

Maintenance Checks

Inspect printheads, filtration and ink circuits according to their actual condition.

Available monitoring and automatic actions depend on the compatible control board, sensors, printhead and software version.

Choose the printhead and ink first, then verify circulation

Verify pressure accuracy, temperature control, nozzle condition and print distance with actual materials and production conditions.

Printhead Ink Path

Confirm the internal circulation path, flow rate and compatible interfaces.

Ink Operating Conditions

Ink type, operating viscosity, pigment content and temperature.

Control Verification

Measure and test conditions for pressure ± 0.05 kPa and temperature ± 0.5 °C.

Continuous Production

Restart after printing stops, 7 × 24 operation and maintenance intervals.

Long-Throw Printing Validation

Target distance, print content, line speed and sample clarity.

Technical note

The circulation mechanism is based on publicly available printhead-manufacturer information. CCS performance values are provided by FHES; final delivery specifications require machine testing.

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