What happens when you press PRINT?

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Contents

- Producing prints the digital way
- Inkjet printing
- The 3 decision groups of a printing system

Image Science in Pictures!
How is a digital print made?
So all we need do is…

- Rip an image into many small dots
- Put them down onto “paper”

Not quite as easy as that!

- What dot density?
  - What size and colour?
  - Where do I put them?

Quickly, easily, cheaply, reproducibly
The inkjet system
Drop size

- Dots per inch (dpi)
- Drop volume
  - Pico litres (pl)
  - 1pl = a 10 micron cube
- Inkjet typically delivers a few pl
The dot formation process

- Inertial spreading
- Wetting
- Absorption
- Evaporation

Dynamics of Printed Drops [http://pgs.iop.org]
The effect of media type

Plain paper

Non absorbent substrates
- Glass
- Plastic film

Coated media
Step 1. What am I printing on?
Ink / Media interaction

- dot size
- dot shape
- dot color
- dot optical density
- color gamut
- dry time

- strikethrough
- cockle
- color bleed
- edge sharpness
- fastness
- gloss
A real example

Plain paper

Cast coated

Polymer

250 microns

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Step 2. What inks shall I print?

Grey Component Replacement
Great for graphics, but a bit coarse for photo
Variable drop size
One route to variable drop size
Add some “light” inks
4, 6, 8… colour options

- 4 colour CMYK
  - Cyan, magenta, yellow, black
- 6 colour. Usually CMYKLCLM
  - Addition of “light” inks in cyan and magenta
  - This can also be 2 spot colours
- 8, 11, 12 etc. colour options
  - Various blacks, white, spot colours
  - Epson UltraChrome HDR
    - Pk, Mk, Lk, LLk, C, Vm, Y, Lc, VLm, Or, Gr
Step 3. How shall I print it?
Interlaced printing

1st pass: First 8 nozzles print 50% of the top half of character

2nd pass: First 8 nozzles print 50% of the bottom half of character while last 8 nozzles print the remaining 50% of top half of character

3rd pass: Last 8 nozzles print the remaining 50% of the bottom half of character
### Circuitry on the cartridge

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984</td>
<td>HP introduces the ThinkJet, a monochrome inkjet printer. 12 nozzles, 13 interconnect lines</td>
</tr>
<tr>
<td>1988</td>
<td>HP introduces the DeskJet, an inkjet printer for office applications. 50 nozzles, 56 interconnect lines</td>
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</tbody>
</table>
The HP Edgeline printhead

- 4.25" Edgeline printhead
- 5 x 2,112 = 10,560 nozzles
- 2 colours per head
- 1,200 dpi
- A size page printing

Control circuitry for the inkjet head

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Circuitry on the cartridge

- New ink formulations
- How much ink is left
- Number of refills
- Brand protection
Conclusions

What happens when you press print?

- What are we printing on?
- What are we printing with?
- What drops, where, how big?

And it all still works!

Usually!

www.rps-isg.org and the blog “A Pixel of Imaging Science”