Print Quality and Speed Performances of New Silicon-Based High Density Magnetographic Head

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Contents

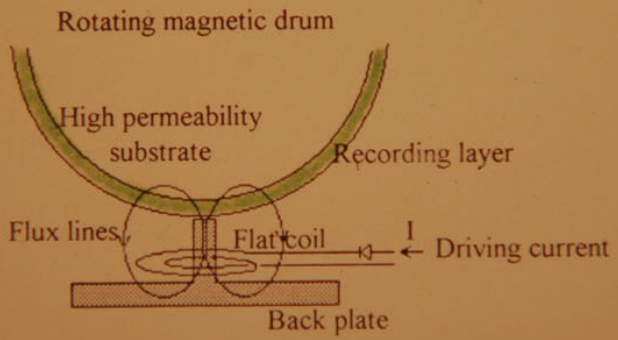
- Printhead design and manufacturing process
- Multiplexing electronics
- Write dynamics
- Power dissipation
- Conclusion

Scope

Magnetographic Printer

- Printheads produce magnetic recording field
- Latent images are formed on hard metallic medium (drum)
- Latent images attract particles of toner
- Mono-component toner is transferred to the paper

Magnetographic Printhead
Principle



vertical recording head

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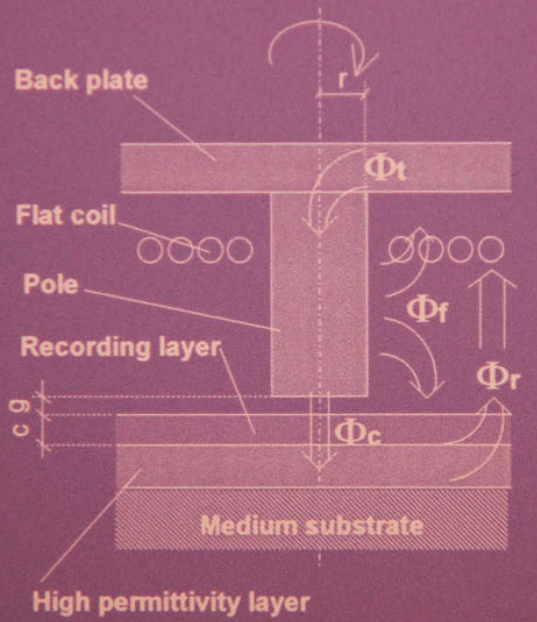
Magnetographic Printhead (cont.)
Design

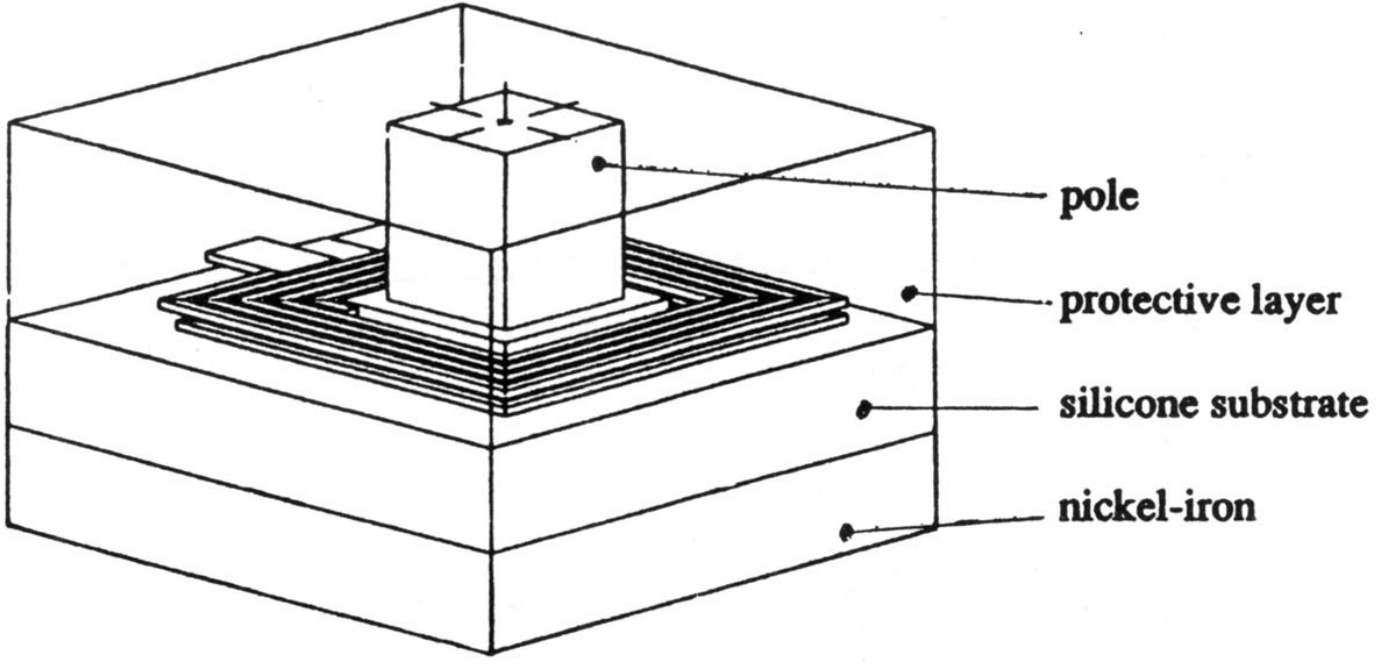
- Silicon substrate
- Double-metal integrated circuit technology used for flat coil and inter connections
- Co-integrated diode matrix on the silicon substrate (multiplexing function)
- Electro-chemical techniques used for magnetic circuit construction (Nickel-Iron)
- Adressability at present : 480 DPI

Magnetographic printhead principle
Vertical Recording



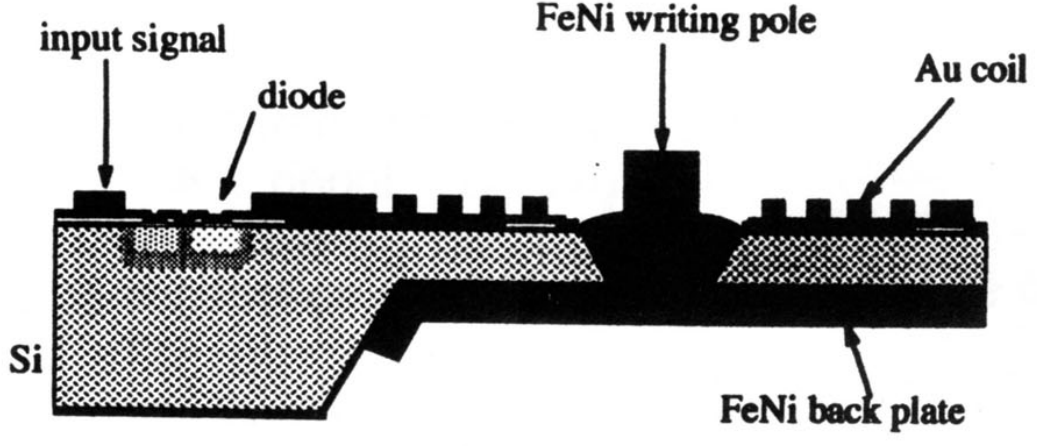
MAGNETOGRAPHIC PRINTHEAD
(NIPSON DEVELOPMENT)

Principle

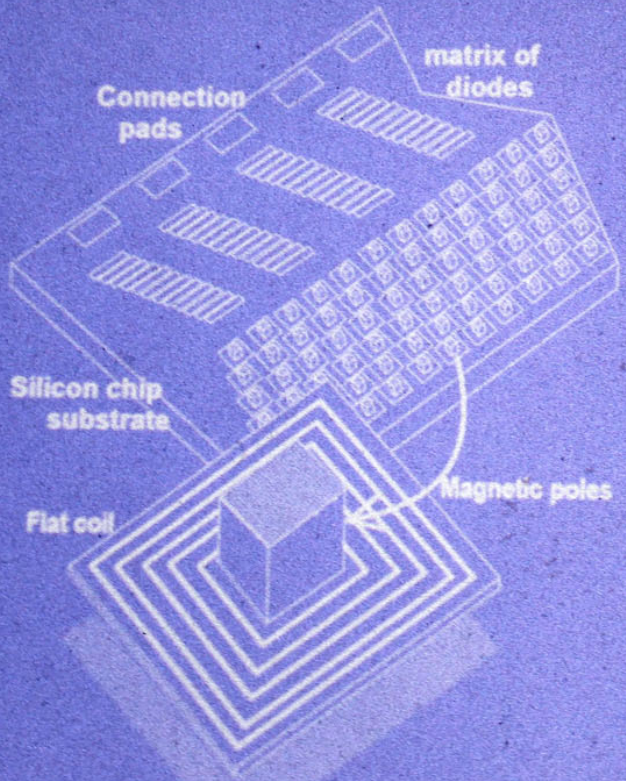


MAGNETOGRAPHIC PRINTHEAD
(NIPSON DEVELOPMENT)

Cross Section



Magnetographic printhead design
Vertical Recording



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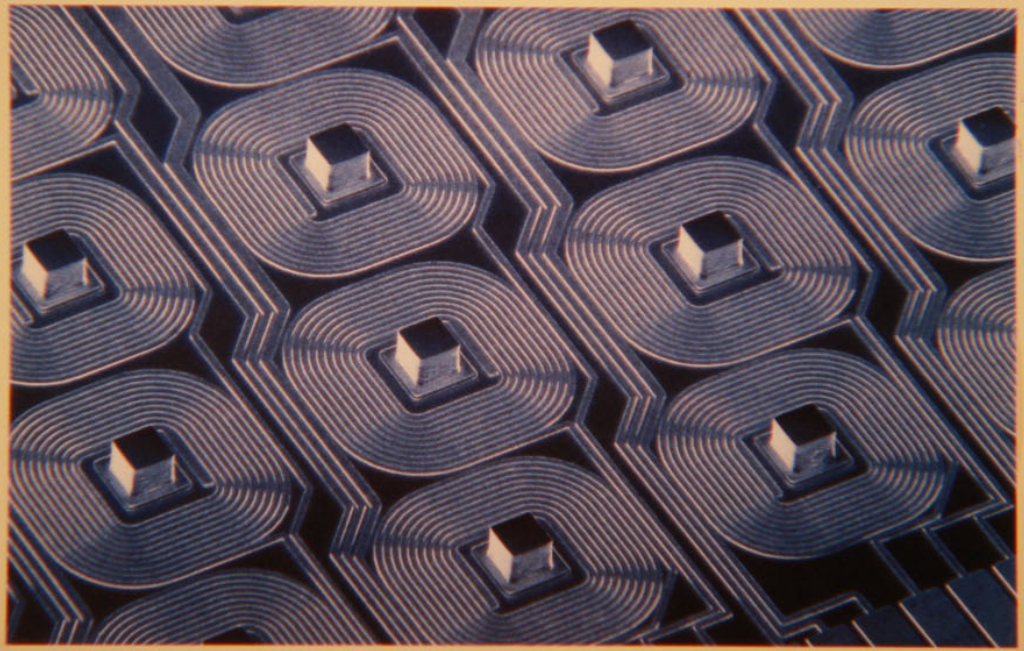
Magnetographic Printhead (cont.)
Pole Array

S.E.M. view of a part of the two-dimension pole array and flat coil



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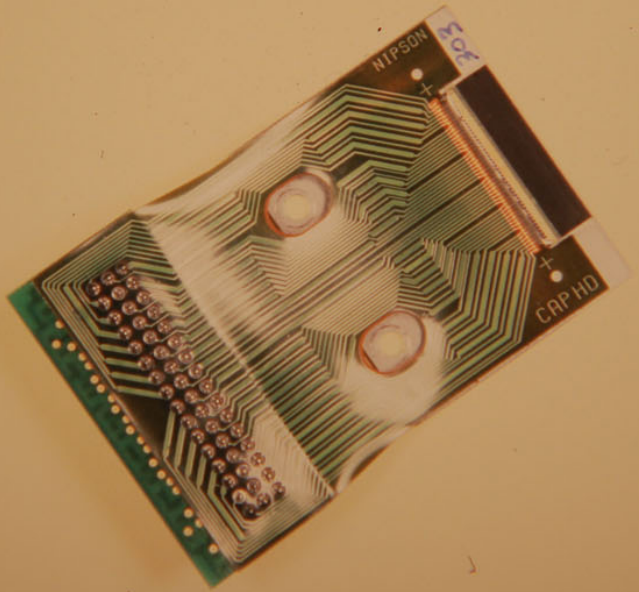
Magnetographic Printhead (cont.)
View of a Module



1"

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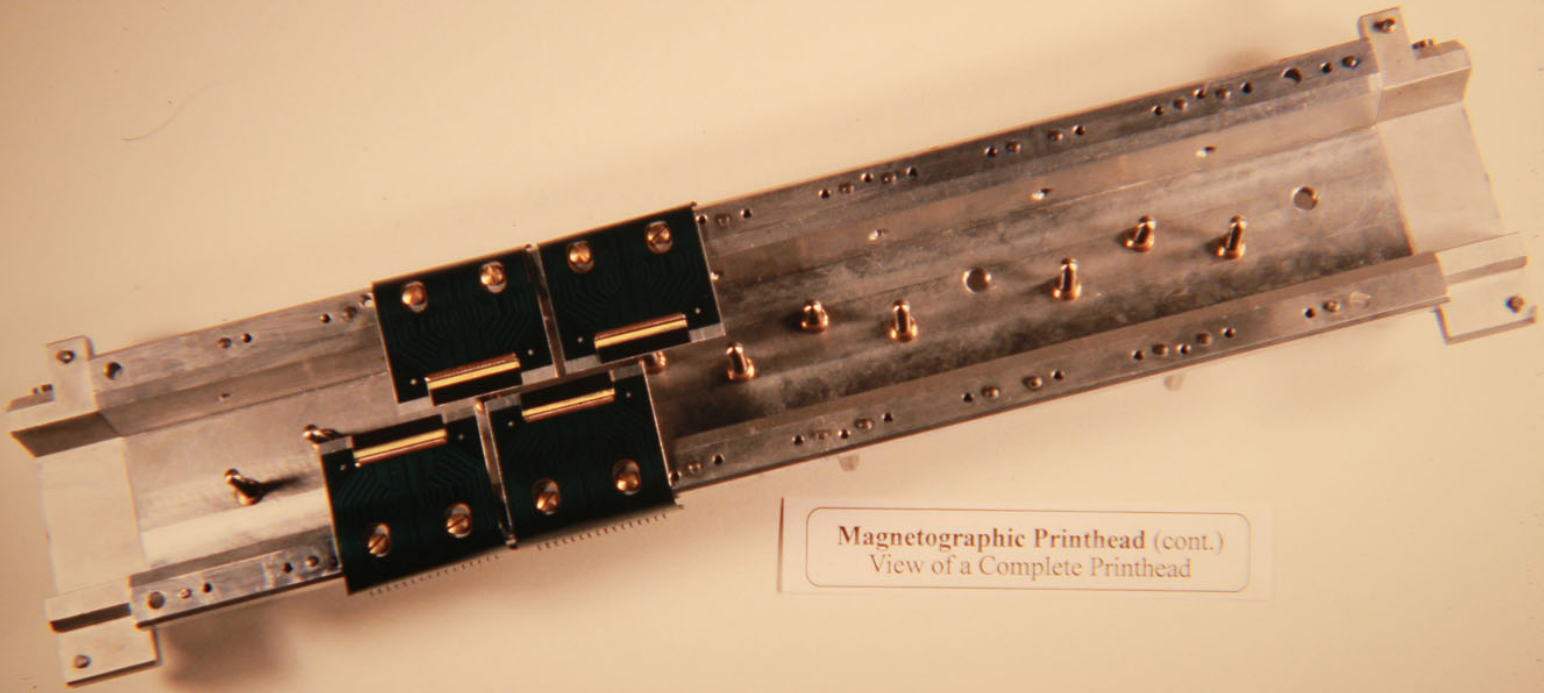
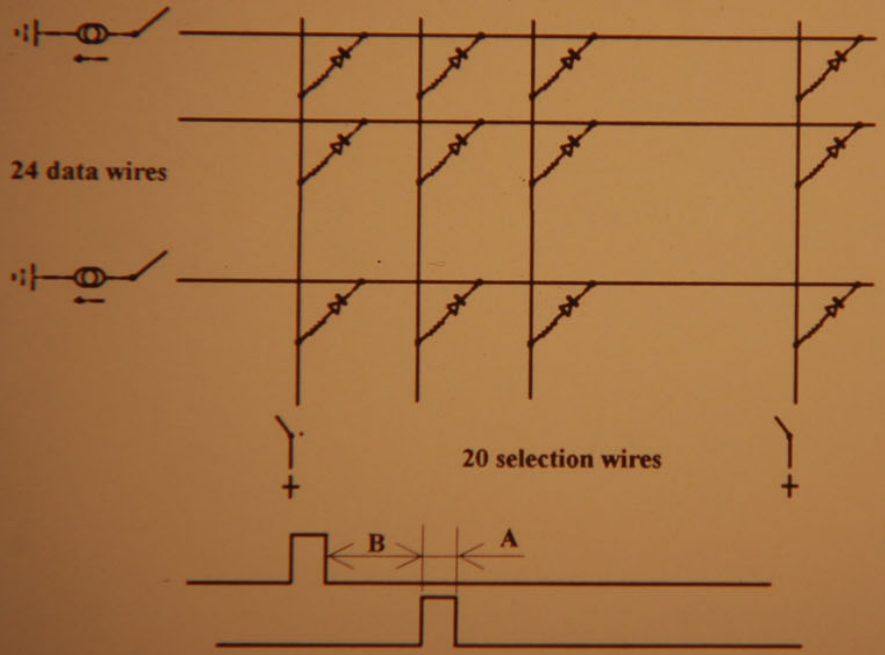


Magnetographic Printhead (cont.)
View of a Complete Printhead

Multiplexing Electronics
Principle



A: recording time
B: time between pulses

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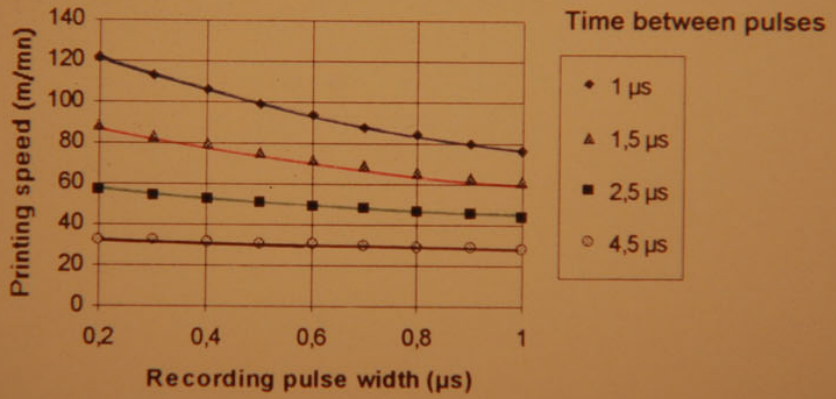
Multiplexing Electronics (cont.)
Maximum Printing Speed



Write Dynamics

- **Input data:**

  Recording time (recording pulse width)

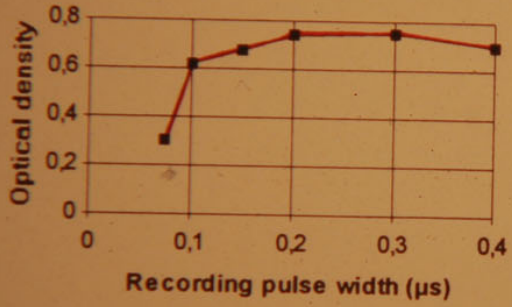
  Time between pulses

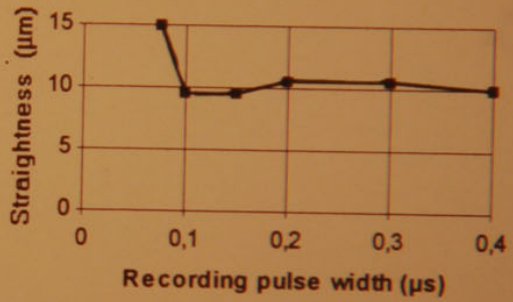
- **Output data:**

  Blackness of lines (optical density)

  Straightness of lines (mean distance between edge and square root best fit)

Write Dynamics (cont.)
Print Quality VS Recording Time





- **Results:**

  - Optimum print quality for a recording time > 0.2 µs

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Power Dissipation
Overview

- **Power dissipation sources:**

  Friction printhead / drum

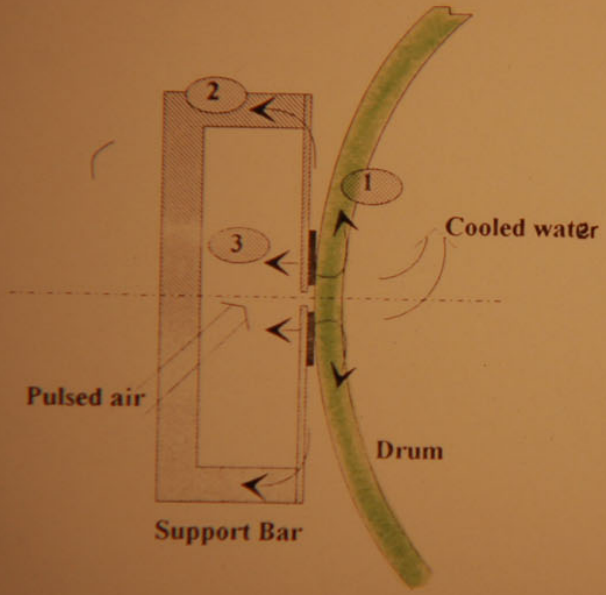
  Joule effect in conductors

- **Corrective actions:**

  Cooled drum

  pulsed air on modules

Power Dissipation (cont.)
Thermal Transfers

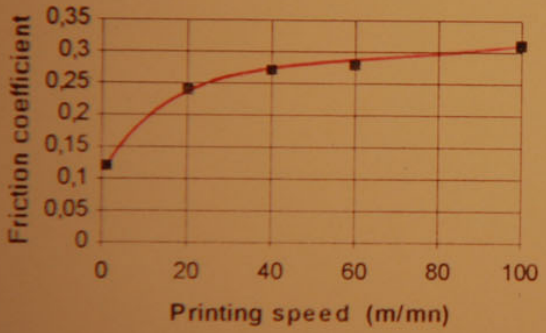


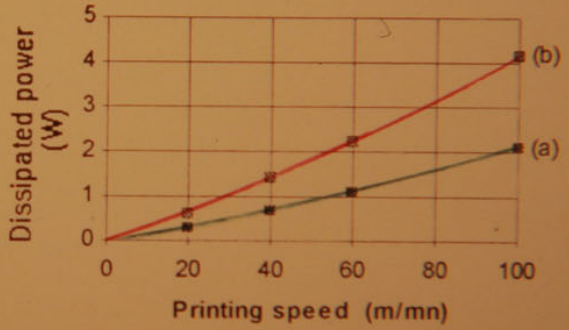
Printhead assembly: cross section

1. Conduction between silicon chip and drum
2. Conduction between head module and support bar
3. Convection on module and support bar

Power Dissipation (cont.)
Friction between Printhead and Drum

- **Friction characteristics** (for 1 head module):



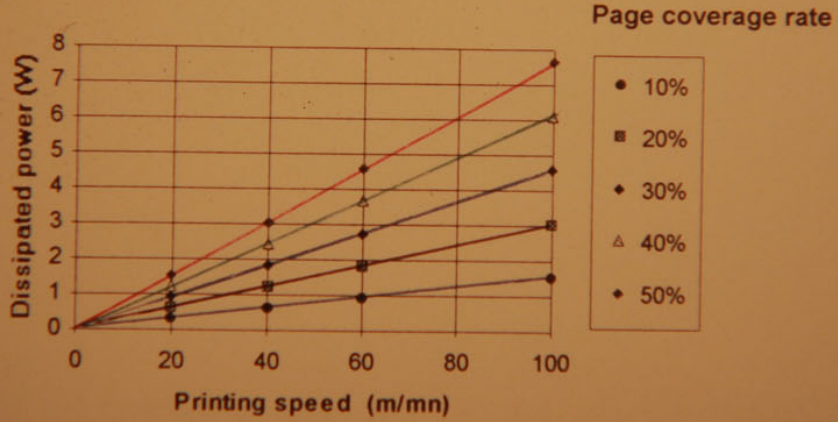


Applied Force: (a): 4 N, (b): 8 N

- **Results:**
  - The power is totaly transferred in the drum
  - No temperature elevation with cooled drum

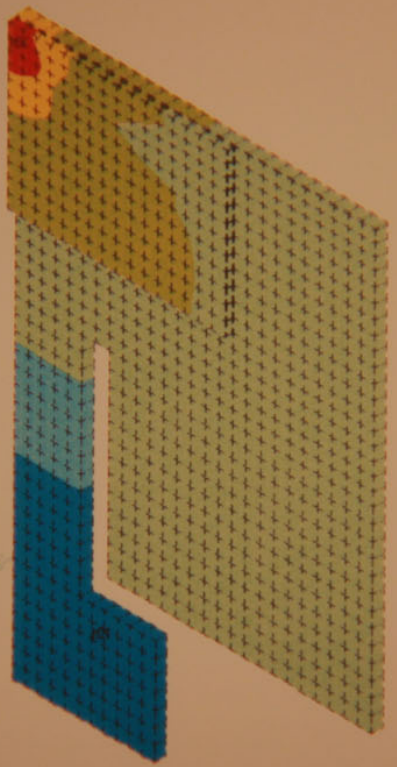
Power Dissipation (cont.)
Joule Effect

Dissipated power per module:



Power Dissipation (cont.)
Thermal Transfer Ratio

- **Characterization:**
  - Finite element method
  - Experimental verification
- **Results in terms of thermal transfer distribution:**
  - Conduction to the drum: 70 %
  - Conduction to the support bar: 9 %
  - Convection : 21 %



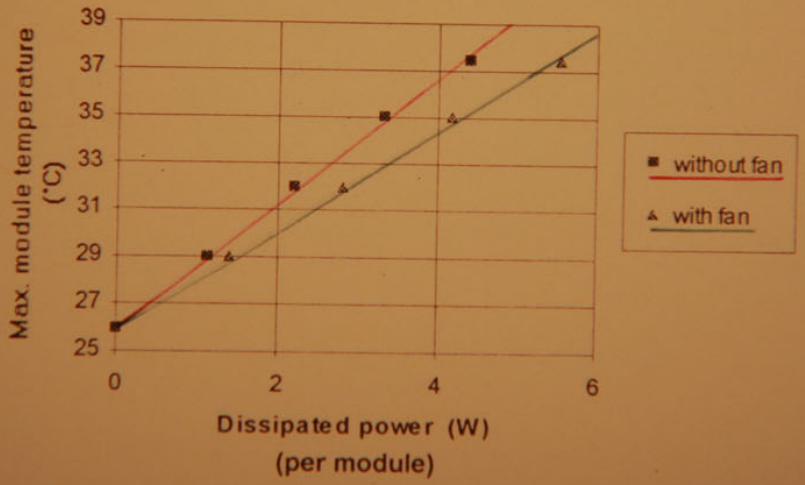
ANSYS 4.4A
JAN 26 1992
10:25:34
POST1 STRESS
STEP=1
ITER=1
TEMP
SMN =22
SMX =36.654

XV =1
YV =1
ZV =1
DIST=22.743
XF =12
YF =12
ZF =0.645

22
24.442
26.885
29.327
31.769
34.212
36.654

Power Dissipation (cont.)
Example of F.E.M. Analysis

Power Dissipation (cont.)
Module Temperature



Power Dissipation (cont.)
Limitations

To avoid:

- Mechanical deformation
- Degradation of tribologic layer

Maximum module temperature: 37 °C

⇨ **Maximum dissipated power per module: 4.8 W**

Conclusion
Operating range

- **With current parameters:**

  - print density: 480 dpi
  - driving current: 0.35A
  - recording pulse width: 0.3µs
  - minimum time between pulses: 1.5µs
  - maximum power dissipation: 4.8W

- **Maximum printing speed:**

  - 60 m/mn with a page coverage rate of 50%
  - 85 m/mn with a page coverage rate of 38%

Further improvement
In Progress

- **Development:**

  - Diminution of the rise time
  - Diminution of the decay time of the driving current

- **New conditions:**

  - recording pulse width: 0.2µs,
  - time between pulses: 1.3µs

- **Speed limit:**

  - 100 m/mn, with a page coverage rate of 45%.

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