

Address Pads

Caleb Fangmeier

Addressing

A Simple Example

Pixel Address Pads

– SiLab Lecture Series – **Address Pads**

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Pixel Address Pads

1 Addressing

2 A Simple Example

3 Pixel Address Pads

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Problem:

Many devices must communicate on shared lines.

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Why?

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- Limited physical space

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Many devices must communicate on shared lines.

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- Limited physical space
- Cost

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Problem:

Many devices must communicate on shared lines.

Why?

- Limited physical space
- Cost
- Simplicity of design

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Solution:
Addressing!

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Solution: Addressing!

-
- Devices take turns talking on shared line

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Solution: Addressing!

- Devices take turns talking on shared line
- Typically controlled by a single “**Master**”

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- Typically controlled by a single “**Master**”
- All other devices are “**Slaves**”

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Solution: Addressing!

- Devices take turns talking on shared line
- Typically controlled by a single “**Master**”
- All other devices are “**Slaves**”
- All **Slave** devices have an **address**

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The "D" Flip-Flop

Address Pads

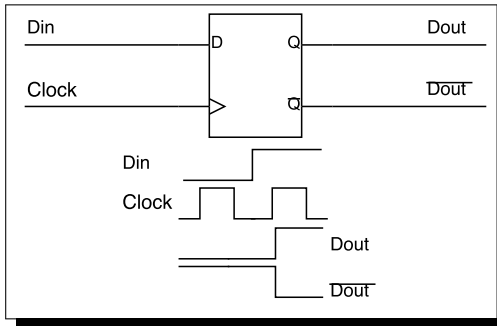
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Pixel Address Pads

- Stores a single bit
- Has a **Data** input and a **Clock** input
- Data updates when clock transitions from low to high



The “D” Flip-Flop

Address Pads

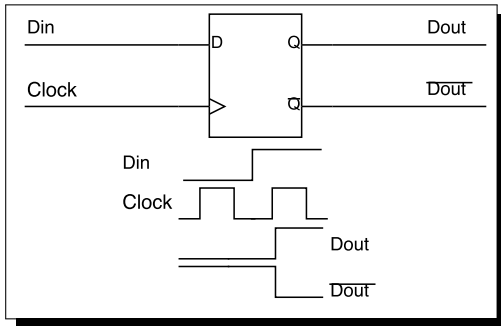
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Pixel Address Pads

- Stores a single bit
- Has a **Data** input and a **Clock** input
- Data updates when clock transitions from low to high



But what if we want to control *multiple* devices with a shared data and clock line?

Address Pads

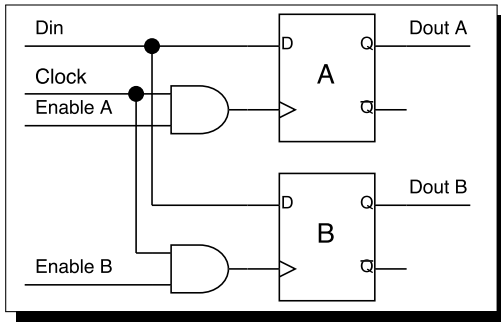
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Pixel Address Pads

- Add an **Enable** line for each device
- Requires $n + 2$ lines
- Data updates only when the **Enable** line is high



Address Pads

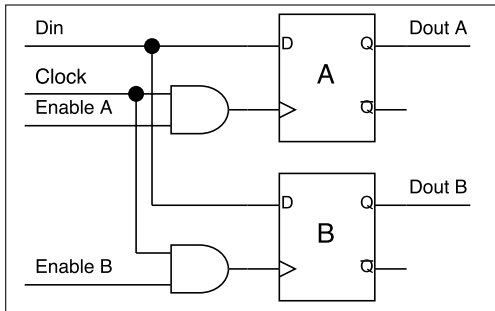
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Pixel Address Pads

- Add an **Enable** line for each device
- Requires $n + 2$ lines
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Cool, but is this *optimal*? Short answer: It depends.

Address Pads

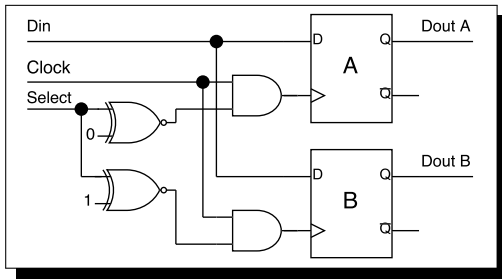
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- Replace individual **Enable** lines with **Select**
- Requires $\lceil \log_2(n) \rceil + 2$ lines
- In this case **A** has address "0", while **B** has address "1"
- This scheme can be extended to any number of bits



Address Pads

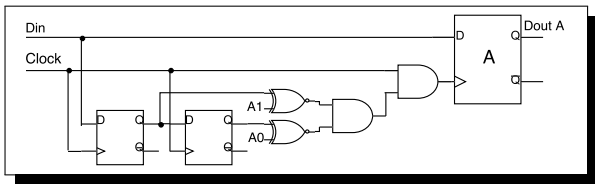
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- Address data is now pushed along data line
- Requires only 2 lines
- In this case **A** has a 2-bit address (A1,A0)
- This diagram is incomplete since it doesn't include end-of-write circuitry, but it demonstrates the idea.



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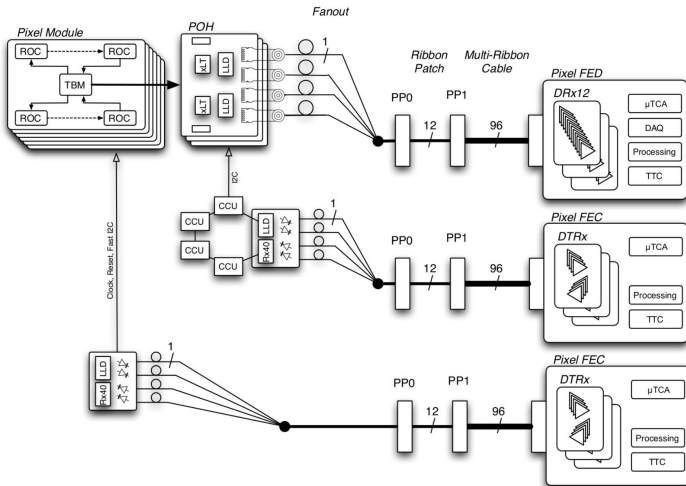
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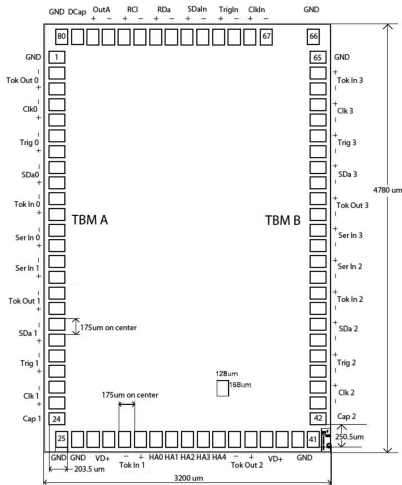
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HA*	Hub Address Pads Internally pulled down
ClkIn	Serial Clock Input
SDaIn	Serial Data Input
RCL	Return Serial Clock
RDa	Return Serial Data

Note: The **data** readout does *not* happen on these lines. That is on OutA.



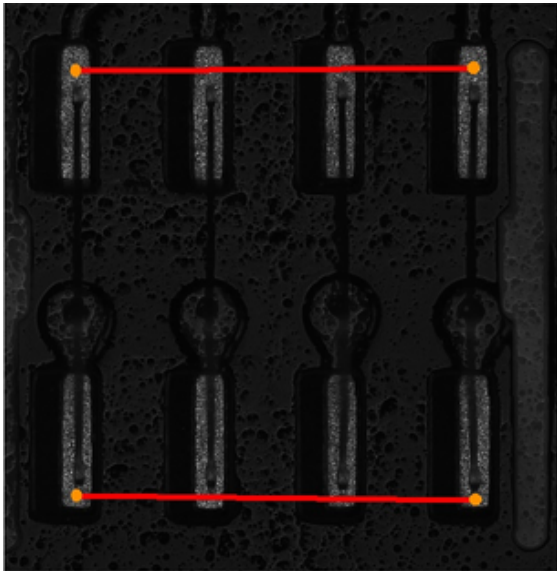
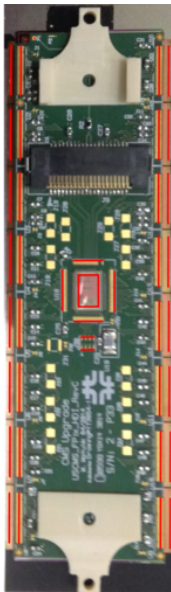
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Serial Command Protocol

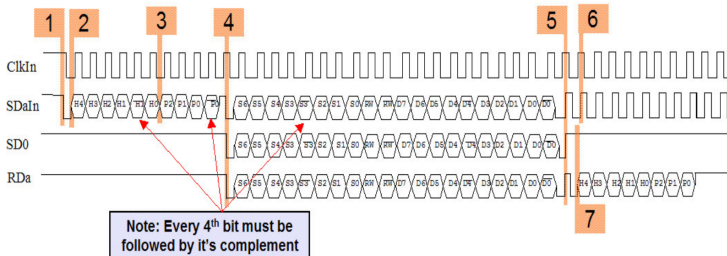
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- 1) Start Signal For Hub
- 2) Hub Address (H4, H3, H2, H1 H0)
- 3) Port Address (P2, P1, P0)
- 4) Start Signal for Readout Chip or Token Bit Manager. Note: Complimentary Bits Must Continue to be Sent During Command to ROC/TBM
- 5) Stop Signal to End Command to Hub
- 6) When inactive, Hub Should Continuously Receive Stops
- 7) Hub, and Port Address are Returned on RDa Line (Note: Complimentary Bits are not returned for Hub Address).

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Technical Report CERN-LHCC-2012-016. CMS-TDR-11, CERN, Geneva, Sep 2012.