Connections to the Beginning: Circuit Boards for CERN

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One of the Hottest Places in the Known Universe
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15 Million Kelvin

http://science.com/science/pho-prominence_6594_600x450.jpg
One of the Hottest Places in the Known Universe

15 Million Kelvin

5.5 Trillion Kelvin

http://science.com/science/pho-prominence_6594_600x450.jpg
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Recreates Big Bang-like Conditions

- Quarks
- Gluons
Connections Must Withstand Radiation and Have High Data Rates
Connections Must Withstand Radiation and Have High Data Rates

Unknown → Silicon Detectors
Connections Must Withstand Radiation and Have High Data Rates

Unknown → Silicon Detectors → Connection
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Unknown → Silicon Detectors → Connection

Silicon Detectors Must Withstand Radiation
Connections Must Withstand Radiation and Have High Data Rates

unknown → silicon detectors → connection
- Withstand Radiation
- High Data Rates
Creating Printed Circuit Boards (PCBs)

Creating Printed Circuit Boards (PCBs)

Space

Power


http://a5.mzstatic.com/us/r30/v4/-de1bde1f374a73/icon128-2x.png
Creating Printed Circuit Boards (PCBs)

Test Integrated Circuits

Creating Printed Circuit Boards (PCBs)

Test Integrated Circuits  Make a Long PCB

Creating Printed Circuit Boards (PCBs)

Test Integrated Circuits

Make a Long PCB

Transmission Causes Loss of Data and Imperfections Cause Reflection
Transmission Causes Loss of Data

Data from Prof. Brewer’s Lab
Transmission Causes Loss of Data and Imperfections Cause Reflection

Imperfections Cause Reflection

Data from Prof. Brewer’s Lab
Design for PCB’s in Ladder

- Component Layer
- Ground Layer
- Signal Layer
- Ground Layer
Component Layer
Component Layer
Design for PCB’s in Ladder

Component Layer

Ground Layer

Signal Layer

Ground Layer

Route: copper connection
Design for PCB’s in Ladder

- Component Layer
- Ground Layer
- Signal Layer
- Ground Layer

Via: hole for routes between layers
Design for PCB’s in Ladder

- Component Layer
- Ground Layer
- Signal Layer
- Ground Layer

Through-hole: hole through entire board for screws
Unrouted Board
First: Component Layer
First: Component Layer
Second: Ground Layer

Through-holes

Vias
Third: Signal Layer
Fourth: Bottom Layer
Finished Board
Testing Integrated Circuits
Testing Integrated Circuits
Testing Integrated Circuits

Laptop ➔ Data Controller (FPGA) ➔ PCB with Chip

Simulates Detector Data

Integrated Circuit
Testing Integrated Circuits

Laptop

Data Controller (FPGA)

PCB with Chip

Integrated Circuit

Laptop

Data Controller (FPGA)

PCB with Chip

http://3.bp.blogspot.com/-DeP9jcQKO2j7ez0/s1600/computer%2Bemoji.png
Making a Long PCB
Making a Long PCB

PCB

3 in
Making a Long PCB

3 in

0.0762 m
Making a Long PCB

For 1.5m = 20 PCBs
Making a Long PCB
Making a Long PCB

Check Signal
Acknowledgements

Professor Forrest Brewer

The Brewer Lab

EUREKA and CSEP

Aditya Dalakoti
PCBs Vs. Wires

1,000 PCBs

PCBs Vs. Wires

1,000 PCBS

100,000 Wires


http://machinedesign.com/site-files/2014/SpeakerWirePromo.gif