Electrical Wiring in DFL and Related Issues

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Madison Workshop

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Objective

Copper wiring of the **Dark Freezer Laboratory** setup for DOM test and calibration.

- Data / Power connection between HUB (DOR cards) and DOMs.
- Local Coincidence (LC) connections between DOMs.

The RAPCAL function will be relied on for the test and calibration.

- Data / Power connections must be compatible with RAPCAL.
Top View of Dark Freezer Laboratory

Freezer walls, floor, and ceiling are 6" thick

J. Hoffman
March 7, 2003
Generic Wiring Scheme

Constraint: One Junction Box per DOR connection (DB9)

Alternatively, “One box per DOR card”. Use the above as a design constraint.

Seacon connectors

LC

“A”

“B”

“A”

“B”

300 DOMs (max)

“Junction Box” on DFL shelf

HUB (64 DOMs)

DOR

DB9

Data/Power Two wire pairs (Quad)

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Junction Box Circuitry

- Power/Data connection to DOMs
- LC connection between the DOMs
- LC connection to the neighboring Junction Boxes
- Adjust signal attenuation
- Adjust signal rise-time
- Impedance matching (if necessary)

Emulate a long cable > 250m for RAPCAL

Signal amplitude at source is fixed: 1.2Vpp
Receiver ADC samples at 20MHz
Receiver ADC dynamic range: 400mVpp
K.H. Sulanke estimates a minimum of 250m cable length for RAP cal.
**Local Coincidence Wiring**

Requirement???: All LC cables must be of the same length.

If this is a true requirement, accommodating the slack of LC wires becomes an issue. Can a circuitry inside Junction Box accomplish the same?

Same length as the distance between Junction Box neighbors

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Terminal Block (or a portion of Junction Box Card)

LC Up

LC Down
Data/Power Cable (DOR/HUB – DOMMB Cable) Options

Requirement: The cables must be shielded.

- EMI-clean environment inside DFL
- Cross-talk management

Quad vs. Twisted Pair??

- Quad cables are difficult to handle (stiffness, bending radius)
- Quad cables have matched impedance for DOR and DOMMB (145Ω)
- DOR card assumes Quad per DB9 connector

- Twisted pairs are available in many varieties
- Matched impedance variety must be custom made.

Custom twin twisted-pair (Two shielded, stranded, 145Ω, twisted-pair cables packaged in one) is most convenient.
Wiring with **Shielded Twisted Pairs**

(The shield connections are not shown.)

- **DB9**
- **LC up**
- **LC down**
- **Data/Power cables**
- **Seacon IceCube Connector**
- **DOM in “Can”**
- **Umbilical Cable** *Unshielded.*
  Alternately long / short (May not be arranged so in DFL.)

- **Seacon Bulkhead**
  A connector on a pigtail cable may be more convenient for handling.

- **Mechanical support??**
  Need a strain relief / anchoring mechanism.

- **How do we combine the two pairs?**
  **Patch Panel vs. Adapter Box**
  The Breakout Box could contain functional components.

- **Terminal Block vs. Connectors**
  Threading thru the DFL wall would be easier w/o connectors.
  Attaching connectors after routing the cables may not be easy.
Alternative: **Twin Shielded Twisted Pairs (Quad)**

(The shield connections are not shown.)

Mechanical support??

Need a strain relief / anchoring mechanism.

One connector for each cable.

No need for Patch Panel or Adapter Box.

Data/Power cables

DB9

LC up

LC down

LC may not share the same Terminal Block as the Data/Power cables

Terminal Block vs. Connectors

Threading thru the DFL wall would be easier w/o connectors

Attaching connectors after routing the cables may not be easy

Seacon Bulkhead

A connector on a pigtail cable may be more convenient for handling.

Seacon IceCube Connector

DOM in “Can”

Umbilical Cable

Unshielded.

Alternately long / short (May not be arranged so in DFL.)

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Alternative: **Shielded Category 5 (CAT5) cable**

- A single CAT5 contains 4 wire pairs. Use just two pairs.
- Lab measurements show that pair-to-pair and cable-to-cable xtalk is acceptable. (A. Laundrie)
- Convenient connectorized solution.
- Needs impedance matching network.
Proposed Solution

- Junction Box should support all three types of cabling:
  - Terminal Block for two twisted pairs or a single quad.
  - RJ45 connector for CAT5.
  - Terminal Block for the LC connections.
  - Junction Box circuitry to be replaceable / selectable

- CAT5 as interim solution while waiting for quad delivery.
DOMMB / DOR Modification Proposal

- Add a low-pass filter to the communication front-end of DOMMB and DOR.
- Make the communications DAC output amplitude programmable.
  - Allow short cable for RAPCAL
  - Reduced cross-talk
  - Reduced EMI in counting house

Resource available
- DOR card
- Rev 3 DOMMB
- Communication / RAPCAL program

Goal:
- Rework / add a filter components to the boards and test COMM, RAP functionality.
- Produce a report by Rev 4 deadline.