

# Breakdown of Multiplicity Vertex Detector Silicon and Electronics Components

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PHENIX-MVD-97-XX

## 1. Silicon Detector Mechanical Assemblies

### 1.1 Rohacell C cages:

- Lead Engineer = Jan Boissevain
- Vendor = Rohm Tech
- 24 total, 12 per MVD half
- Machine 50 good cages
- 25 spares
- Cages sealed with 0.5mil Parylene
- Silicon detectors glued to cages
- Fully populated houses 3 inner and 3 outer detectors
- Partially populated houses 3 inner and 1 outer detector

### 1.2 Silicon Strip Detectors:

- Lead Engineer = Jon Kaustinsky
- Vendor = Micron Semiconductor
- 112 detectors total
- 256 channels/detector x 112 detectors = 28,672 channels
- Inner detector = 72 + 20 spares = 90  
90 x \$1200/det = \$110,400
- Outer detector = 40 + 12 spares = 52  
50 x \$1500/det = \$78,000

### 1.3 Silicon Pad Detectors:

- Lead Engineer = Jon Kapustinsky
- Vendor = Micron Semiconductor
- 12 Pad detectors per endcap x 2 endcaps = 24 Pad detectors
- 24 detectors x 252 channels/detector = 6048 channels
- 24 + 6 spares = 30 total
- 30 X \$1750 = \$52,000

## 1.4 Kapton Cables:

- Lead Engineer = Jan Boissevain
- Vendor = Litchfield Inc
- Cable is glued then wirebonded to Silicon detector and MCM
- 6 silicon strip detector species x 1900NRE/species
- Inside/Bottom cable
  - 24+16 spare @ 30.85/cable
- Inside/Middle cable
  - 24+16 spare @ 37.20/cable
- Inside/Top cable
  - 24+16 spare @ 57.25/cable
- Outside/bottom cable
  - 24+16 spare @ 27.75/cable
- Outside/Middle cable
  - 8 + 7 spare @ 78.5/cable
- Outside/Top cable
  - 8+7 spare @ 98.5/cable
- Silicon Pad Detector cable or transition board
  - 1900NRE + 24+16spare @ 100/cable

## 2.0 Front-End Electronics

### 2.1 Multi-Chip Module

- Lead Engineer = Jon Kapustinsky/Gary Richardson
- Vendor = Lockheed Martin
- 112 Strip Detectors + 24 Pad Detectors = 136MCM
- With detector spares = total of 172 detectors
- Fabricate 200 MCM
- 256 channels/MCM
- 19 die/MCM : 8 preamp, 8AMUADC, 2 Heap Manager, 1 OPAMP

#### 2.1.1 MCM Output Cable:

- Lead Engineer = Jan Boissevain
- Vendor = Litchfield Inc?
- Cable is glued then wirebonded to MCM
- Cable is attached via connector to power communication cable.
- One MCM output cable per MCM = 200 output cables.
- 50 spares
- 250 x 50\$/cable = \$12500

## 2.2 Electronic Die

### 2.2.1 TGV32

- Lead Engineer = Chuck Britton
- Vendor = ORBIT
- Need to instrument 200 MCM @ 256 ch/MCM = 51200 (includes spares)
- 32 channel/preamp die
- Assume 50% yield from ORBIT
- $51200 \text{ ch} \times 1 \text{ die}/32\text{ch} \times 1/0.5 \text{ yield} = 3200 \text{ die}$
- ORBIT quote = \$65000

### 2.2.2 AMUADC32

- Lead Engineer = Mike Emery
- Vendor = MOSIS
- Need to instrument 200MCM @ 256 ch/MCM = 51200 (includes spares)
- 32 channel/ AMUADC die
- Assume 50% yield from process
- $51200 \text{ ch} \times 1 \text{ die}/32\text{ch} \times 1/0.5 \text{ yield} = 3200 \text{ die}$
- HP/MOSIS quote = \$50000 (Common FEE)

### 2.2.3 Heap Manager

- Lead Engineer = Nance Ericson
- Vendor = Chip Supply (Joey Mahey)
- 1 Xilinx 4005 FPGA/MCM x 200 = 200 4005FPGA
  - $200 \times 132\$/4010 = 26400\$\$
- 1 Xilinx 4010 FPGA/MCM x 200 = 200 4010 FPGA
  - $200 \times 160\$/4005 = 32000\$\$

### 2.2.4 OPAMP

- Lead Engineer = Chuck Britton
- Vendor =
- Model = CLC426?
- 1 multiplicity sum driver/MCM = 200 Multiplicity sum OPAMPS
- $200 \times 2\$/\text{opamp} = \$400$

## 3.0 Power/Communication Cable, Motherboard, Daughterboard

### 3.1 Motherboard

- Lead Engineer = Kevin McCabe/Jan Boissevain
- Vendor = ?
- 8 layer board?
- (2 boards+2spare) x 2 species = 8 total; Instrument half of spares so 6B
- 3K NRE + 1000\$/B + 1Kstuff setup+200\$/B
- 1 board services 42 MCM fully populated or 34 MCM partially populated.
- Components
  - LDO
    - LDO for MCM power filtering - 5 LDO associated with 1 DC Pow conn
    - Vendor = ?
    - Model = ?
    - 35LDOs/B x 6B x 5\$/LDO
  - Polyswitch resettable fuses
    - Vendor = Raychem
    - Model = ?
    - 20 per DC connector
    - 20 fusesx 7conn/B x 6Bx1\$/fuse
  - ADC
    - Vendor = ?
    - Model = ?
    - ADC for monitoring of MCM temperature sensor
    - 2ADC/B x 6B x 10\$/ADC
  - Multiplexers
    - Vendor = ?
    - Model = ?
    - for spy channels, signals, T,V
    - 10Multiplexers/B x 6B x 10\$/ea
  - Serial link
    - Vendor = ?
    - Model = ?
    - To read out ADC and control multiplexer
    - 1 serial link/B x 6B x 25\$/link
  - PECL clock synthesizer and fanout
    - Vendor = ?
    - Model = ?
    - 1 synth and 1 fanout per board
    - 1+1PecL/B x 6B x 10\$/ea

- Motherboard Connectors:
  - LVDS headers
    - Vendor = ?
    - Model = ?
    - Maps to Power Communication cable (data out of MCM)
    - Connects to DCMIM cable
    - 7 LVDS headers/B x 6B x 10\$/header
  - DC Power connectors
    - Vendor = Panduit?
    - Model =
      - Panduit MAS-CON IDC: 10contact, 8A, (0.156pitch), 18 gauge wire
      - Header (MLSS156-10TA): 31.7mmx3.7mmx3.2mm
      - Right angle Plug (CT156F18-10): 31.7mmx0.9mmx19.6mm
    - Comes from Power Distribution Box
    - Maps to Power Communication Cable
    - 1 Provides power to 6 MCMs
    - 7 DC Power connectors x 7B x 1\$/conn
  - Distribution headers
    - Vendor =
    - Model =
    - 60 contact connector @ 25ml pitch
    - 7 header go to T&C via cable
    - 2 to Silicon HV bias supply via cable
    - 1 is discriminator sum output and goes to Trigger Interface via cable
    - 10H/B x 6B x 10\$/H
  - Power Communication Cable Connector
    - Vendor =
    - Model =
    - Connects to Power Communication Cable
    - 160 Contact Connector
    - 6conn/B x 6B x 10\$/conn
  - Daughterboard connector
    - Vendor =
    - Model=
    - Connects to daughterboard
    - 2 - 80 contact connector for total of 160 contacts
    - 2H/B x 6B x 10\$/H

### 3.3 Power/Communication Cable

- Lead Engineer = Kevin McCabe/Jan Boissevain
- Vendor = ?
- Rigid Flex board
- 1 cable per 6 MCM
- 2 species x (12+3spares) = 30 cables
- 1k NRE x 2species + 800\$/cable + 1K stuff setup + 50\$/B stuff x 30B
- Capacitors
  - For Silicon bias:
    - Vendor =
    - Model =
    - 6/cable x 30cab x 10\$/cap
  - For comparator:
    - Vendor =
    - Model =
    - 6/cab x 30cab x 1\$/cap
  - For something else:
    - Vendor =
    - Model =
    - 6/cable x 30cab x 1\$/cap
- LVDS translator
  - Vendor =?
  - Model=?
  - 6/cab x 30cab x 10\$/lvds
- Pecl clock fanout
  - Vendor=?
  - Model=?
  - 1/cab x 30cab x 10\$/pecl
- Connector from MCM output cable to Power Communication Cable
  - 2 connectors per MCM output cable - 1 analog, 1 digital
  - Vendor = Elco
  - Model # 08-6212-024-001-000
  - 24 contact 0.5mm pitch, surface mount horizontal ZIF, 0.4A,
  - 30 cables x 2conn/cable x 2\$/each (1000min) = 2000\$
- Connector from Power Communication to Motherboard
  - Vendor =
  - Model =
  - 160 contact
  - 1conn/cable x 30cab x 10\$/cable

### 3.4 Daughterboard

- Lead Engineer = Kevin McCabe/Jan Boissevain
- Vendor =
- 1 daughterboard services 6 endcap MCM
- 4 boards total + 4 spares = 8 total boards
- Capacitors
  - For Silicon bias:
    - Vendor=?
    - Model=?
    - 6/cable x 8B x 10\$/cap
  - For comparator
    - Vendor =?
    - Model=?
    - 6/cab x 8B x 1\$/cap
  - For something else:
    - Vendor=?
    - Model=?
    - 6/cable x 8B x 1\$/cap
- LVDS translator
  - Vendor=?
  - Model=?
  - 6/cab x 8B x 10\$/lvds
- Pecl clock fanout
  - Vendor=?
  - Model=?
  - 1/cab x 8B x 10\$/pecl
- Connector: daughterboard to motherboard:
  - Vendor=?
  - Model=?
  - 2 - 80 contact connectors per board
  - 2H/B x 8B x 10\$/H
- Connector from MCM output cable to Power Communication Cable
  - Vendor=Elco
  - Model # 08-6212-024-001-000
  - 2 connectors per MCM output cable - 1 analog, 1 digital
  - 24 contact 0.5mm pitch, surface mount horizontal ZIF, 0.4A
  - Cost included in Power communication cable connectors

## 4.0 Interface Modules

### 4.1 Timing and Control Interface

- Lead Engineer= Mike Emery
- Vendor = ?
- 2 boards + 1 spare + 1 cleantent = 4 total
- 4 layer board 400 x 400mm?
- 2 board set including transition module, 120x400mm
- 3.5K NRE + 1000/B x 4B
- Stuffing costs = 1Ksetup +(200\$x4)+(50\$x4)
- Connector for cable from Motherboard (2 motherboards per T&C)
  - Vendor=?
  - Model=?
  - 14conn/B x 4B x 10\$/conn
  - 60 contact connector
- Connector from transition module to VME crate
  - Vendor=?
  - Model=?
  - 3conn/B x 4B x 10\$/B
- Connector on VME crate
  - Vendor=?
  - Model=?
  - 3conn/B x 4B x 10\$/B
- Cable from Motherboard to T&C
  - Vendor=?
  - Model=?
  - 7 cables/Moth x 2 moth/TCIM x 4TCIM x 16.4ft/cable x7\$/ft
- 1 Glink receiver/B x 4B x 250\$/Glink
  - Vendor=?
  - Model=?
- Glue logic/B x 4B x 50\$/glue
- 1 ARCNET rec/B x 4B x 80\$/arcnet
  - Vendor=?
  - Model=?

## 4.2 Data Collection Interface

- Lead Engineer = Nance Ericson/Mark Allen
- Vendor=?
- 2 layer board?
- 2 board set including transition module
- $28B + 7sp = 35B$
- $3K\ NRE + (35B \times 600\$/B) + 1k\ stuff\ setup + (35B \times 50\$/B) + (35B \times 200\$/B) + 1k\ stuff\ setup + (35B \times 50\$/B)$
- FPGA
  - Vendor=?
  - Model=?
  - $3\ FPGA/B \times 35B \times 15\$/FPGA$
- glue Logic  $\times 35B \times 55\$/B$
- Glink transmitter
  - Vendor=?
  - Model=?
  - $3\ Glink\ /B \times 31B \times 305\$/trans$  (Assume all PHENIX generic trans & reduce spares)
- Connector from transition module to VME crate
  - Vendor=?
  - Model=?
  - $3conn/B \times 35B \times 10\$/B$
- Connector on VME crate
  - Vendor=?
  - Model=?
  - $3conn/B \times 35B \times 10\$/B$
- Cable from Motherboard to DCMIM
  - Vendor=?
  - Model=?
  - $1\ cables/DCM \times 35DCM \times 16.4ft/cable \times 7\$/ft$
  - Connector on both sides of cable
    - Vendor=?
    - Model=?
    - $2\ conn/cable \times 35\ cab \times 10\$/conn$

## 4.3 Trigger Interface

- Lead Engineer = Gary Turner
- Vendor =
- $4B + 4sp = 8$  total
- 4 layer board?; 2 board set
- 1 board per 24 multiplicity sum
- $3.5KNRE + (8B \times 800/B) + (8B \times 300/B)$
- stuff:  $2Ksetup + (8 \times 50) + (8 \times 200)$
- ADC
  - Vendor=?
  - Model=?
  - $24ADC/B \times 8B \times 10\$/ADC$
  - 1 ADC per trigger sum
- FPGA
  - Vendor=?
  - Model =?
  - $3FPGA/B \times 8B \times 15\$/FPGA$
- GLINK transmitter
  - Vendor=?
  - Model=?
  - Instrument 2 spares
  - $3Glink\ trans/B \times 6B \times 305/trans$
- Glue logic
  - $glue \times 8B \times 55\$/B$
- Connector from transition module to VME crate
  - Vendor=?
  - Model=?
  - $3conn/B \times 35B \times 10\$/B$
- Connector on VME crate
  - Vendor=?
  - Model=?
  - $3conn/B \times 35B \times 10\$/B$
- Cable from Motherboard to Trigger interface
  - Vendor=?
  - Model=?
  - $1\ cable/B \times 16.4ft/cable \times 8B \times 7\$/ft$

## 4.4 Power Distribution Box

- Lead Engineer = Jan Boissevain
- Vendor=
- One power distribution box separated into four sections, one per motherboard.
- 2 layer board?
- 4 boards + 4 spares= 8 boards total.
- 3.5KNRE + 300\$/B + 1Ksetup + 200\$/Bstuff
- Scanning ADC/Multiplexer
  - Vendor=?
  - Model=?
  - Need to monitor 140 voltages
  - 20 ADC total x 10\$/each
- Polyfuse
  - Vendor=Raytech?
  - Model=?
  - 1 per voltage (140)
  - 140 x 1\$/fuse
- Filter Capacity
  - Vendor=?
  - Model=?
  - 1 per voltage (140)
  - 140 x 1\$/cap
- Arcnet card?
  - Vendor=?
  - Model=?
  - Cost=?
- Cable from Power Connector on Motherboard
  - Vendor=?
  - Model=?
  - 7cables/Motherboard x 8B x 16.4ft/cable x 2\$/ft
- Connector to attach to DC cable from Motherboard
  - Vendor = Panduit?
  - Model =
    - Panduit MAS-CON IDC: 10contact, 8A, (0.156pitch), 18 gauge wire
    - Header (MLSS156-10TA): 31.7mmx3.7mmx3.2mm
    - 7 cables/B x 1conn/cable x 8B x 1\$/conn
- Cable from Silicon Bias on Motherboard
  - Vendor=?
  - Model=?
  - 2cable/motherboard x 8B x 16.4ft/cable x 7\$/ft
- Connector to attach to Silicon bias cable from motherboard
  - Vendor =
  - Model =
  - 60 contact connector @ 25ml pitch
  - 2H/B x 8B x 10\$/H
- Cables and Connectors and interlocks from Low and High Voltage Supplies
  - ???