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Report on SVX II Cabling for CDF Cable Committee

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Abstract

We report on the cabling under development for the SVX II detector. Starting from the center of the detector, we report on the following electrical data and power cables: HDI, PC pigtail, power + signal Cu-Kapton cable, junction board, analog low voltage cable, digital low voltage cable, high voltage bias cable, remote voltage sensing cable, FIB timing signal cable, and FIB Fanout status cable. We report on the following fiber optic cables: DOIM fiber optic pigtail, jacketed DOIM ribbon fiber optic Glink cable. We report on the following electrical cooling and interlock control cables: control signal cable, adapter cable, RTD readout cables, and CAENET control cable.

1 Introduction

Schematics of the SVX II cabling are shown in Figures 1 and 2. ISL and L00 cables are not shown but are in most cases identical to those for the SVX II.

2 Electrical data and power cables

See included documents for all but the FIB Fanout (FFO) status cable, described below.

2.1 FFO Status Cable

Each FFO (one per FIB crate or 4 per end for total SVXII + ISL system) sends LVDS status signals back to the Silicon Readout Controller (SRC) via a four-bit shielded cable. Each of the 4 bits is the logical 'OR' of various error and status conditions as selected by the registers. The cable may be grounded at the Fanout end to allow return of common-mode currents. The four status bits provide monitoring of over 20 different error conditions within the Fanout, including

but not limited to: failure of the +5.0, -5.2, or -2.0 power supplies, 8 protocol errors in the SRC command frame structure, 4 FIB generated error conditions, received optical power too low, and 3 Glink lock status bits. Details on the cable are as follows:

- Description: FFO to SRC status cable
- Length : approx. 300 ft
- Number: 1 per FIB rack or 4 per end.
- Location 1: FFO board (collision hall walls)
- Location 2: SRC (1st floor counting room)
- Cable: Belden Data Twist # 1624P, CAT 5 4 twisted pair with flamarrest jacket and foil shield. (see spec sheet from vendor). N.B. Dervin Allen has some concerns regarding the strength of this cable, but has stated willingness to use it if necessary.
- Max. pulling tension: 25 lbs.
- Min. bend radius: 1".
- Connector: AMP SDL connector # 3-520424-3 and associated parts.

Pin	Signal
1	STATUS 0 (true side)
2	STATUS 0 (invert side)
3	STATUS 1 (true side)
4	STATUS 1 (invert side)
5	STATUS 2 (true side)
6	STATUS 2 (invert side)
7	STATUS 3 (true side)
8	STATUS 4 (invert side)

Table 1: Signals and pinout for FIB Fanout - SRC Status cable.

3 Fiber Optic Cables

3.1 DOIM

The DOIM fiber ribbon cables send data and a clock signal from the SVXII and ISL port cards (PC) to the Fiber Interface Boards (FIB), which will be located in relay racks hung from the collision hall walls. From the PC to about the face of the COT, the fiber ribbon is unjacketed (DOIM pigtail), which then connects to a jacketed ribbon cable. This jacketed cable runs up the face of the COT, out the 30 degree slots and onto a radial cable tray. From this tray, the

cables will enter a special cable tray that runs from the detector to the FIB relay racks. The cables plug in to the back of the FIB boards. The total distance from the COT to the FIB is estimated at 20 meters. The maximum number to a FIB rack is 9 FIB x 10 DOIM/FIB + 10 spares = 100 ribbons (approximate). There are a total of 8 FIB racks on the collision hall walls: 4 W and 4 E, divided equally for SVX II and ISL. See Figures 3 and 4.

Pigtail Version

- Description: DOIM fiber optic pigtail
- Length : TX: approx. 2 m (varies with bulkhead, and SVXII vs ISL vs L00), RX: 30 cm
- Number: 1 per DOIM or 180 per end for SVX II.
- Location 1: TX: DOIM module on PC, RX: DOIM module on FIB Transition Module.
- Location 2: TX: face of COT, near end of ISL space tube, RX: panel of FIB Transition Module.
- Cable: Alcoa-Fujikura unjacketed 12-fiber ribbon. # WB01261C1102. Ribbon composed of fibers with glass core and plastic cladding (62.5um/125um) encased in a matrix of UV curable acrylate with cross-linking material. Fire rating better than jacketed version–very good but hard to quantify. Cross sectional dimensions approx. 1mm x 3 mm.
- Connector: TX: USCONEC MT Ferrule, RX: USCONNEC MT Ferrule plus MTP panel mount housing. See Figures.
- Tensile strength: short term–22 lbs; long term–11 lbs.
- Radiation hardness: tested with hadrons to more than 200 KRad with no observed degradation. Exceeds specification.

Jacketed Version

- Description: DOIM fiber optic jacketed cable
- Length : approx. 20 meters.
- Number: 1 per DOIM or 180 per end for SVX II.
- Location 1: face of COT, near end of ISL space tube.
- Location 2: panel of FIB Transition Module.
- Cable: Alcoa-Fujikura jacketed 12-fiber ribbon. # WP01261C1102. Jacketed version is plenum rated (UL-910) with PVDF (polyvinyl dynefluoride) jacket and aramid yarn insulation. Jacket surrounds same unjacketed "pigtail" version described above. Cross sectional dimensions approx. 2mm x 5 mm.
- Connector: detector end: USCONEC MT Ferrule, FIB end: USCONNEC MT Ferrule plus MTP panel mount housing. See Figures.
- Tensile strength: short term–180 lbs; long term–91 lbs.

3.2 G-Link Cables

The fiber optic Glink cable system sends serialized data from the FIB racks to the optical splitter rack in the 1st floor counting room. After the split, the same cables are used to send the data to both the SVT and to the VRBs. In addition the SRC uses the same cables to control the FFOs. As the ISL signals are not used by the SVT, their cables run directly from their FIB racks to the VRBs. The L00 signals may be used by the SVT, in which case its cables will follow the same paths as those for SVXII. Note that these cables have been purchased from Morse Cable and have all been delivered to FNAL.

- Description: Glink fiber optic cable.
- Lengths: FIB to splitter rack (and splitter to FFO): 300'; splitter to SVT: 80'; splitter to VRB: 70'. See Figure.
- Number: See attached document.
- Locations: See attached document.
- Cable: Optical Cable Corporation (OCC) Zero Halogen Core-locked 6-channel (i.e. 6 fiber) breakout style cable. 50/125 um fiber. # B06-095Z-A3FB/1FC/900-R. See Figure.
- Connector: Siecor ST connector with metal body and ceramic ferrule. # 95-101-44
- Tensile strength: long term–1200 N.
- Min. bend radius: 9.5 cm.

4 Cooling and Interlock System

The Cooling system is designed to remove 2.5 kW of heat from the SVX and about 2 kW of heat from the ISL. The chillers for these systems are located in the Alcove in the Assembly Hall. On each end of the detector, the cooling system provides 3 independent control loops for the SVX bulkheads and 1 for the SVX PC cooling rings. ISL has a similar layout, but the distribution of the coolant to "bulkheads" is handled differently. A schematic of the cooling system is shown in Fig. 8. The Interlock system will reside in the Interlock Rack on the first floor, and it serves to ensure that the SVX and ISL are:

- In a safe temp. range: $T_{SVX} < 15^{o}C$, $T_{ISL} < 20^{o}C$
- Cooling lines are sub-atmospheric from COT face in
- Power supply currents are within range
- kept dry

In addition, the interlock system is sensitive to "large" leaks (whereby air is sucked into the system), or the remote possibility of significant clogging.

The Interlock system has been specified and written up in CDF4737. In short, it consists of a Siemens 575 PLC which is connected to one or more 505 crates via a remote base controller (RBC). The 575 crate contains the 575 CPU (master) where the interlock code resides. Also in the 575 crate are a MVME162 (slave), a SCRAMNET reflective memory card, and a V288 CAEN controller, all of which facilitate the communication between the 575 CPU and the power supplies. The 505 crates contain the I/O modules which include analog inputs, analog outputs, digital inputs, digital outputs, and RTD modules for reading in temperatures. The values of the I/O are updated in the 575 memory through the 575-RBC connection. The values of the various I/O are made available to a PC through a network interface module (NIM) which resides in the 505 crate. The PC runs the software "Fix Dynamics" from Intellution, which displays and logs the data in a user-defined environment. A schematic of the Interlock system is shown in Fig. 9.

The majority of the cabling which will be used in the Cooling and Interlock systems will emanate from the Interlock rack on the first floor, and be routed to either the detector, or the alcove in the Assembly Hall. Most of these cables will run through the main cable tray, and be routed to the East and West ends of the detector. Another set of cables will be routed from the Interlock rack to the Alcove in the Assembly Hall where the SVX/ISL chillers will be located. In Table 1, we list the various I/O which run from the Interlock Rack to the Detector, and in Table 2 we list the I/O which run to the Alcove in the Assembly Hall. SVX and ISL have the same requirements, except for the temperature probes inside the detector volume.

Here, we briefly describe the layout of these cables. See Fig. 10 for a schematic of the cable layout. Cables CI-ANA01 and CI-DIG01 carry analog and digital I/O to/from the PLC thorugh the main cable tray to junction boxes which reside on both ends of the detectors. On each end of the detector, we control the cooling of 3 bulkheads and 3 sets of Port Card rings (ISL control does not have the same modularity, but has a similar number of control loops). The junction boxes will contain DIN rail connectors, relays, and a power supply for the field devices. Smaller multiconductor cables will distribute the power and route signals from the DIN rail in the junction box to each of the field devices. Another set of analog signal cables, CI-RTD01, carry the RTD analog signals from the PLC to the junction box and connect to DIN rail connectors. Some of the RTD lines are used in the cooling control loops and cable size is not a big limitation. The majority of the RTDs though will be mounted on the bulkheads of the SVX and ISL, and therefore the associated cabling must go through the 30° crack. For that reason, the 22 AWG wires are first transitioned down to a 30 AWG, 0.05" centerline footprint using the ALTECH #502-4216 DIN rail connector. The transition cable CI-RTD02 (Allied Electronics #136-060-0100) reduces the flat cable from 0.05" centerline to 0.025" centerline spacing. This cable is terminated with standard IDC connectors. This transition cable then attaches to a 30 AWG, 0.025" flat cable (CI-RTD03) which passes through the 30° slot and is IDC terminated just at the inside of the ISL spaceframe. This cable then connects to a similar cable (CI-RTD04) which runs to the SVX barrels and has the RTDs connected to the ends, which are glued to the bulkheads.

Another set of cables, CI-ANA02 and CI-DIG02, carry the analog and digital I/O from the Interlock rack to a junction box in the Alcove on the first floor. From the junction box, we expect to use similar multiconductor cable to distribute the I/O to the chillers and the other

apparatus which reside in the Alcove.

Finally, we expect to carry the CAEN control signals on COAX cable. Due to the broad use of such cables, we are awaiting a decision by the CDF cable committee on a standardized coax cable. These cables will run from the Interlock rack, through the main cable tray, and be routed to the 4 FIB/PS racks which are mounted on the walls on the east and west side of the detector.

These cables are described in more detail on the following pages.

Item	Signal	I/O	#Wires	#Sets	A	D
Bulkhead and Port Card Control Loops						
Flow-Orifice w/PDT	4-20 mA	AI	2	10	20	
Leak Monitor PDT	4-20 mA	AI	2	10	20	
Ctrl Valve - Prop. Solen.	4-20 mA	AO	2	10	20	
Flow Temp. - RTD	0.25 mA	RTD Input	4	10	40	
Return Solen. Valve	24 Vdc	DO(relay)	2	10		20
30° Vacuum TC Gauge	4-20 mA	AI	4	10	40	
RTDs on SVX Bkhd (6x10/bkhd)	0.25 mA	RTD Input	4	60	240	
RTDs on ISL Bkhd (6x10/bkhd)	0.25 mA	RTD Input	4	50	200	
Manifold at face of Detector						
Supply Pressure	4-20 mA	AI	2	2	4	
Return Pressure	4-20 mA	AI	2	2	4	
Bypass Ctrl Valve - Prop. Solen.	4-20 mA	AO	2	2	4	
Supply Temp. - RTD	0.25 mA	RTD Input	4	2	8	
Return Temp. - RTD	0.25 mA	RTD Input	4	2	8	
Humidity sensor	???	AI	2	?	?	
Total SVX					408	20
Total ISL					368	20

Table 2: Various I/O which run from the Interlock Rack to the East and West Ends of the Detector for the SVX. Totals for both SVX and ISL are shown. The ISL wiring is the same as SVX, except for the number of RTDs, as indicated in the Table. Key: A=Analog, D=Digital, AI=Analog Input, AO=Analog Output, DI=Digital INput, DO=Digital Output, RTD=Resistive Temperature Device.

Item	Signal	I/O	#Wires	#Sets	A	D
Alcove in Assembly Hall - Chillers						
Chiller Remote ON/OFF	24 Vdc	DO	2	1		2
Chiller Pump ON Status	24 Vdc	DI	2	1		2
Chiller Compressor ON Status	24 Vdc	DI	2	1		2
Chiller Power ON Status	24 Vdc	DI	2	1		2
Remote Setpt Enable-Relay	24 Vdc	DO	2	1		2
Remote Setpt	4-20 mA	AO	2	1	2	
Alarm #1	24 Vdc	DI	2	1		2
Alarm #2	24 Vdc	DI	2	1		2
Alarm #3	24 Vdc	DI	2	1		2
Supply Pressure	4-20 mA	AI	2	1	2	
Return Pressure	4-20 mA	AI	2	1	2	
Supply Temp. - RTD	0.25 mA	RTD Input	4	1	4	
Return Temp. - RTD	0.25 mA	RTD Input	4	1	4	
Bypass Ctrl Valve - Prop. Solen.	4-20 mA	AO	2	1	2	
Supply Solenoid Valve	24 Vdc	DO(relay)	2	1		2
Return Solenoid Valve	24 Vdc	DO(relay)	2	1		2
Alcove in Assembly Hall - Air Separator						
Level Transmitter	4-20 mA	AI	2	1	2	
Pressure Transmitter	4-20 mA	AI	2	1	2	
N_2 Ctrl Valve	4-20 mA	AO	2	1	2	
Vacuum Ctrl Valve	4-20 mA	AO	2	1	2	
Vacuum Pump - Contactor	24 Vdc	DO(relay)	2	1		2
Vacuum Pump - Status	24 Vdc	DI	2	1		2
Gas Flow Meter	4-20 mA	AI	2	1	2	
Alcove in Assembly Hall - Instrumentation Panel						
Electrical Conductivity	4-20 mA	AI	2	1	2	
Test Section Fluid Temp RTD	0.25 mA	RTD Input	4	1	4	
Test Section Fluid Heater	24 Vdc	DO(relay)	2	1		2
Supply Temp RTD	0.25 mA	RTD Input	4	1	4	
Sterilizer - Remote On/OFF	24 Vdc	DO(relay)	2	1		2
Sterilizer - Power Status	24 Vdc	DI	2	1		2
Deionizer Ctrl Valve	4-20 mA	AO	2	1	2	
Alcove in Assembly Hall - Power Outage Pump						
Pump Remote ON/OFF	24 Vdc	DO	2	1		2
Pump - ON Status	24 Vdc	DI	2	1		2
Supply Solenoid Valve	24 Vdc	DO(relay)	2	1		2
Return Solenoid Valve	24 Vdc	DO(relay)	2	1		2
Total SVX					38	38
Total ISL					38	38

Table 3: Various I/O which run from the Interlock Rack to the East and West Ends of the Alcove in the Assembly Hall for the SVX.Totals for both SVX and ISL are shown. The ISL wiring is the same as SVX, except for the number of RTDs, as indicated in the Table. Key: A=Analog, D=Digital, AI=Analog Input, AO=Analog Output, DI=Digital INput, DO=Digital Output, RTD=Resistive Temperature Device.

Module Type	#I/O SVX	#I/O ISL
RTD Inputs	74	64
Analog Input	34	34
Analog Output	12	12
Digital Input	0	0
Digital Output	10	10

Table 4: Total Analog and Digital I/O wire pairs which go from the Interlock Rack on first floor to Detector for the SVX and the ISL .

Module Type	#I/O SVX	#I/O ISL
RTD Inputs	4	4
Analog Input	6	6
Analog Output	5	5
Digital Input	9	9
Digital Output	10	10

Table 5: Total Analog and Digital I/O wire pairs which go from the Interlock Rack on first floor to Alcove on first floor for the SVX and the ISL.

Total Analog Pairs needed = 398 (Four-wire RTD inputs count as 2 pairs.)
Total Digital Pairs needed = 58.

The analog and voltage signals will be carried from the Interlock Rack to the two locations by 22 AWG (7x30) stranded multiconductor cable. Although we do not expect much switching in the digital signals, we plan to separate the analog and digital signals into different multiconductors. Below we describe the various cables which are used to carry these analog and digital signals. A schematic of the layout is shown in Fig. 10

There are currently 57 analog I/O for the SVX and 57 analog I/O for the ISL, each which requires a maximum of 20 mA. Therefore, a total current of 1.14 Amps is required for each system. This power is provided for by an external supply, which we will fuse at 2 Amps. In case of a short on any of the 22 AWG lines, each conductor can handle in excess of 4 Amps, so that we believe we have ample safety margin. There are 29 Digital I/O for SVX and 29 for ISL. The digital outputs will either directly turn ON/OFF the field devices or switch relays which in turn switch the field device ON/OFF. We expect that 20 mA per channel is sufficient for digital outputs. The digital inputs draw a maximum of 15 mA (at 30 V). Therefore we expect that the digital I/O should not exceed a total of 580 mA for each the SVX and ISL. A 2 Amp fuse provides ample overcurrent protection on the 22 AWG wires. The RTD module provides a constant 250 μA excitation current for the RTDs. Since these are current sourcing lines, a short to ground does not affect the current which is sourced.

Cables carrying Analog Voltages

ANALOG CABLE TYPE #1: Cooling & Interlock Analog I/O Cable (CI-ANA01)

- Manufacturer BELDEN # 9330
- Cable type Power Limited Tray Cable 300 Volts
- Function Analog signals for CONTROL & INSTRUMENTATION of SVX/ISL
- Number Approx. 23 for both SVX & ISL
- Length 250-300 FT.
- Location 1 FIRST FLOOR
- Connector 1 DIN rail
- Location 2 DETECTOR FACE
- Location 2 Junction box at detector face
- Comments 22 AWG, 7x30 stranded, 4 twisted pairs, individually shielded, each with drain wire. Overall shield. Interlock Rack to Detector; 0.36" OD
- Fire Safety– Flame test rating: CSA FT4; UL 1581; NEC Type PLTC; Insulation material: Flame Retardant PVC; Jacket material: Flame Retardant PVC.
- Electrical Considerations– Connector pin-out assignments: ???; Power conductor ampacity: 3.5 A; Power conductor overcurrent protection: POWER SUPPLY FUSED @ 2 Amps; High voltage conductor rating: 300 V RMS.
- Mechanical Considerations— Bend radius for cable carrier: 3.5"; Radiation resistance analysis N/A.

ANALOG CABLE TYPE #1: Cooling & Interlock Analog I/O Cable (CI-ANA02)

- Manufacturer BELDEN # 9330
- Cable type Power Limited Tray Cable 300 Volts
- Function Analog signals for CONTROL & INSTRUMENTATION of SVX/ISL
- Number Approx. 23 for both SVX & ISL
- Length ???
- Location 1 FIRST FLOOR
- Connector 1 DIN rail
- Location 2 Instrumentation Panel in Alcove - Assembly Hall
- Connector 2 DIN rail
- Comments 22 AWG, 7x30 stranded, 4 twisted pairs, individually shielded, each with drain wire. Overall shield. Interlock Rack to Detector; 0.36" OD
- Fire Safety– Flame test rating: CSA FT4; UL 1581; NEC Type PLTC; Insulation material: Flame Retardant PVC; Jacket material: Flame Retardant PVC.

- Electrical Considerations– Connector pin-out assignments: ???; Power conductor ampacity: 3.5 A; Power conductor overcurrent protection: POWER SUPPLY FUSED @ 2 Amps; High voltage conductor rating: 300 V RMS.
- Mechanical Considerations— Bend radius for cable carrier: 3.5"; Radiation resistance analysis N/A.

RTD CABLE TYPE #1: Cooling & Interlock Analog I/O Cable (CI-RTD01)

- Manufacturer BELDEN # 9330
- Cable type Power Limited Tray Cable 300 Volts
- Function Analog signals for CONTROL & INSTRUMENTATION of SVX/ISL
- Number Approx. 49 for both SVX & ISL
- Length 250-300 FT.
- Location 1 FIRST FLOOR
- Connector 1 DIN rail
- Location 2 Junction box at detector face
- Connector 2 DIN rail with ALTECH CORP. #502-4216
- Comments 22 AWG, 7x30 stranded, 4 twisted pairs, individually shielded, each with drain wire. Overall shield. Interlock Rack to Detector; 0.36" OD
- Fire Safety– Flame test rating: CSA FT4; UL 1581; NEC Type PLTC; Insulation material: Flame Retardant PVC; Jacket material: Flame Retardant PVC.
- Electrical Considerations– Connector pin-out assignments: ???; Power conductor ampacity: 3.5 A; Power conductor overcurrent protection: 0.25 mA constant current source from PLC; High voltage conductor rating: 300 V RMS.
- Mechanical Considerations— Bend radius for cable carrier: 3.5"; Radiation resistance analysis N/A.

RTD CABLE TYPE #2 Adapter cable for BH/PC RTDs (CI-RTD02)

- Manufacturer Thomas & Betts (Distributor: Allied Electronics)
- Part number 136-060-0100
- Cable type FLAT RIBBON CABLE
- Function ADAPTER CABLE FROM .05" TO 0.025" CENTERLINE SPACING (RTD READOUT)
- Number 4 per end (3 for SVX, 1 for ISL)
- Length 12 in.
- Location 1 NEAR DETECTOR FACE
- Connector 1 ALTECH CORP. #502-4216
- Location 2 NEAR DETECTOR FACE

- Connector 2 AMP HEADER #786090-7
- Comments 30 AWG Solid Cu, 0.05" TO 0.025" CENTERLINE SPACING
- Fire Safety– Flame test rating: ???; Insulation material: PVC; Jacket material: No jacket.
- Electrical Considerations– Connector pin-out assignments: ???; Power conductor ampacity: 0.75 A; Power conductor overcurrent protection: ???; High voltage conductor rating: 150 V rms.
- Mechanical Considerations– Bend radius for cable carrier: N/A; Optical cable stress analysis: N/A; Radiation resistance analysis: N/A.

RTD CABLE TYPE #3 Bulkhead/Port Card RTD Probe Readout (CI-RTD03)

- Manufacturer SPECTRA-STRIP #425-3016
- Cable type RIBBON TWIST & FLAT
- Function RTD READOUT
- Number 3 per end for SVX II
- Length 12-15 FEET
- Location 1 DETECTOR FACE
- Connector 1 AMP RECEPTACLE #786103-7
- Location 2 END OF ISL SPACEFRAME
- Connector 2 AMP HEADER #786090-7
- Comments 30 AWG
- Fire Safety– Flame test rating: VW-1 IEC, 332-1; Insulation material: HALOGEN FREE - FLAME RETARDANT POLYOLEFIN; Jacket material: HALOGEN FREE - FLAME RETARDANT POLYOLEFIN.
- Electrical Considerations– Connector pin-out assignments: ???; Power conductor ampacity: 0.75 A; Power conductor overcurrent protection: ???; High voltage conductor rating: 150 V.
- Mechanical Considerations– Bend radius for cable carrier: N/A; Optical cable stress analysis: N/A; Radiation resistance analysis: N/A.

RTD CABLE TYPE #3 Bulkhead/Port Card RTD Probe Readout (CI-RTD04)

- Manufacturer SPECTRA-STRIP #425-3016
- Cable type RIBBON TWIST & FLAT
- Function RTD READOUT
- Number 3 per end for SVX II
- Length approx. 6 FEET
- Location 1 END OF ISL SPACEFRAME DETECTOR FACE

- Connector 1 AMP RECEPTACLE #786103-7
- Location 2 SVXII BULKHEADS
- Connector 2 N/A RTD ON BULKHEAD
- Comments 30 AWG
- Fire Safety– Flame test rating: VW-1 IEC, 332-1; Insulation material: HALOGEN FREE - FLAME RETARDANT POLYOLEFIN; Jacket material: HALOGEN FREE - FLAME RETARDANT POLYOLEFIN.
- Electrical Considerations– Connector pin-out assignments: N/A; Power conductor ampacity: 0.75 A; Power conductor overcurrent protection: N/A; High voltage conductor rating: 150 V.
- Mechanical Considerations– Bend radius for cable carrier: N/A; Optical cable stress analysis: N/A; Radiation resistance analysis: N/A.

Cables carrying Digital Voltages

DIGITAL CABLE TYPE #1: Cooling & Interlock Digital I/O Cable (CI-DIG01)

- Manufacturer BELDEN # 8308
- Cable type MID-HIGH CAPACITANCE COMPUTER CABLE
- Function CONTROL & INSTRUMENTATION SIGNALS FOR SVXII
- Number 3 8-pair cables per end for SVX II
- Length 250-300 FT.
- Location 1 FIRST FLOOR
- Connector 1 DIN Rail
- Location 2 Junction Box at Detector face
- Connector 2 Din Rail
- Comments Twisted pairs, overall shield; 0.384" OD.
- Fire Safety– Flame test rating: NEC CODE: CMG CABLE MEETING CSA FT4 OR AWM 2464; Insulation material: SR PVC; Jacket material: PVC.
- Electrical Considerations– Connector pin-out assignments: ???; Power conductor ampacity: 1.5 Amps; Power conductor overcurrent protection: POWER SUPPLY at 1.5 Amps; High voltage conductor rating: 300 V RMS.
- Mechanical Considerations— Bend radius for cable carrier: 3.9"; Radiation resistance analysis N/A.

DIGITAL CABLE TYPE #1: Cooling & Interlock Digital I/O Cable (CI-DIG02)

- Manufacturer BELDEN # 8308
- Cable type MID-HIGH CAPACITANCE COMPUTER CABLE
- Function CONTROL & INSTRUMENTATION SIGNALS FOR SVXII
- Number 5 8-pair cables per end for SVX II
- Length ???
- Location 1 FIRST FLOOR
- Connector 1 DIN Rail
- Location 2 Junction Box in Alcove in Assembly Hall
- Connector 2 Din Rail
- Comments Twisted pairs, overall shield; 0.384" OD
- Fire Safety– Flame test rating: NEC CODE: CMG CABLE MEETING CSA FT4 OR AWM 2464; Insulation material: SR PVC; Jacket material: PVC.
- Electrical Considerations– Connector pin-out assignments: ???; Power conductor ampacity: 1.5 Amps; Power conductor overcurrent protection: POWER SUPPLY at 1.5 Amps; High voltage conductor rating: 300 V RMS.

- Mechanical Considerations— Bend radius for cable carrier: 3.9"; Radiation resistance analysis N/A.

COAX CABLE TYPE #1: CAENET control and PS Enable (CI-DIG03)

- Manufacturer BELDEN # ???
- Cable type RG-58 COAXIAL CABLE
- Function CAENET CONTROL / 5V ENABLE LINE TO POWER SUPPLIES
- Number up to 8 per end for SVX II + ISL + L00
- Length approx. 300 FEET
- Location 1 FIRST FLOOR
- Connector 1 NOT YET SPECIFIED
- Location 2 FIB RACKS IN COLLISION HALL
- Connector 2 LEMO
- Comments EXACT CABLE NOT YET SPECIFIED.
- Fire Safety– Flame test rating: ???; Insulation material: ???; Jacket material: ???.
- Electrical Considerations– Connector pin-out assignments: ???; Power conductor ampacity: ???; Power conductor overcurrent protection: FUSED POWER SUPPLY; High voltage conductor rating: AT LEAST 150 V.
- Mechanical Considerations– Bend radius for cable carrier: LESS THAN 3.5"; Optical cable stress analysis: N/A; Radiation resistance analysis: N/A.

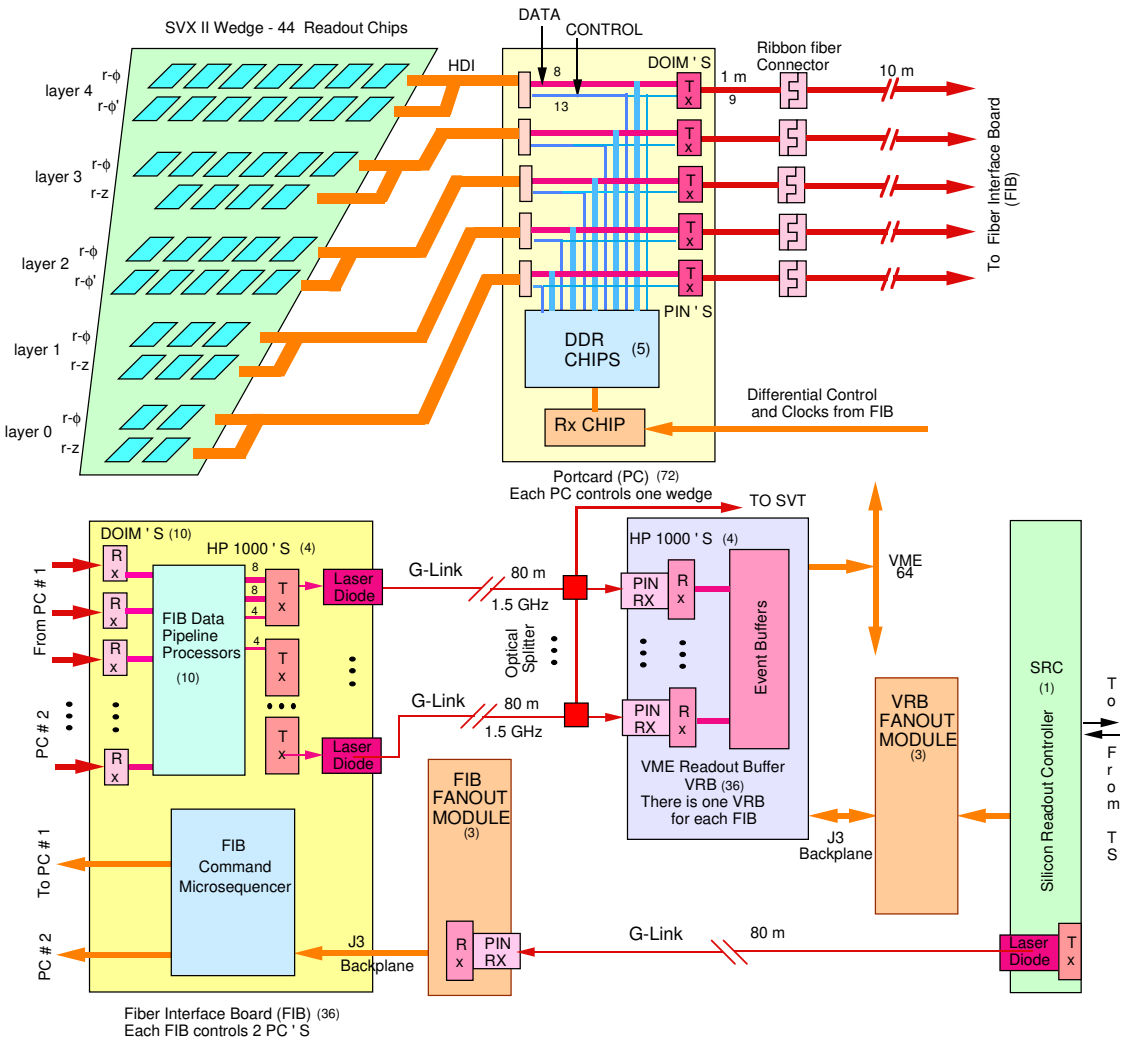

Figure 1: Schematic of SVX II DAQ

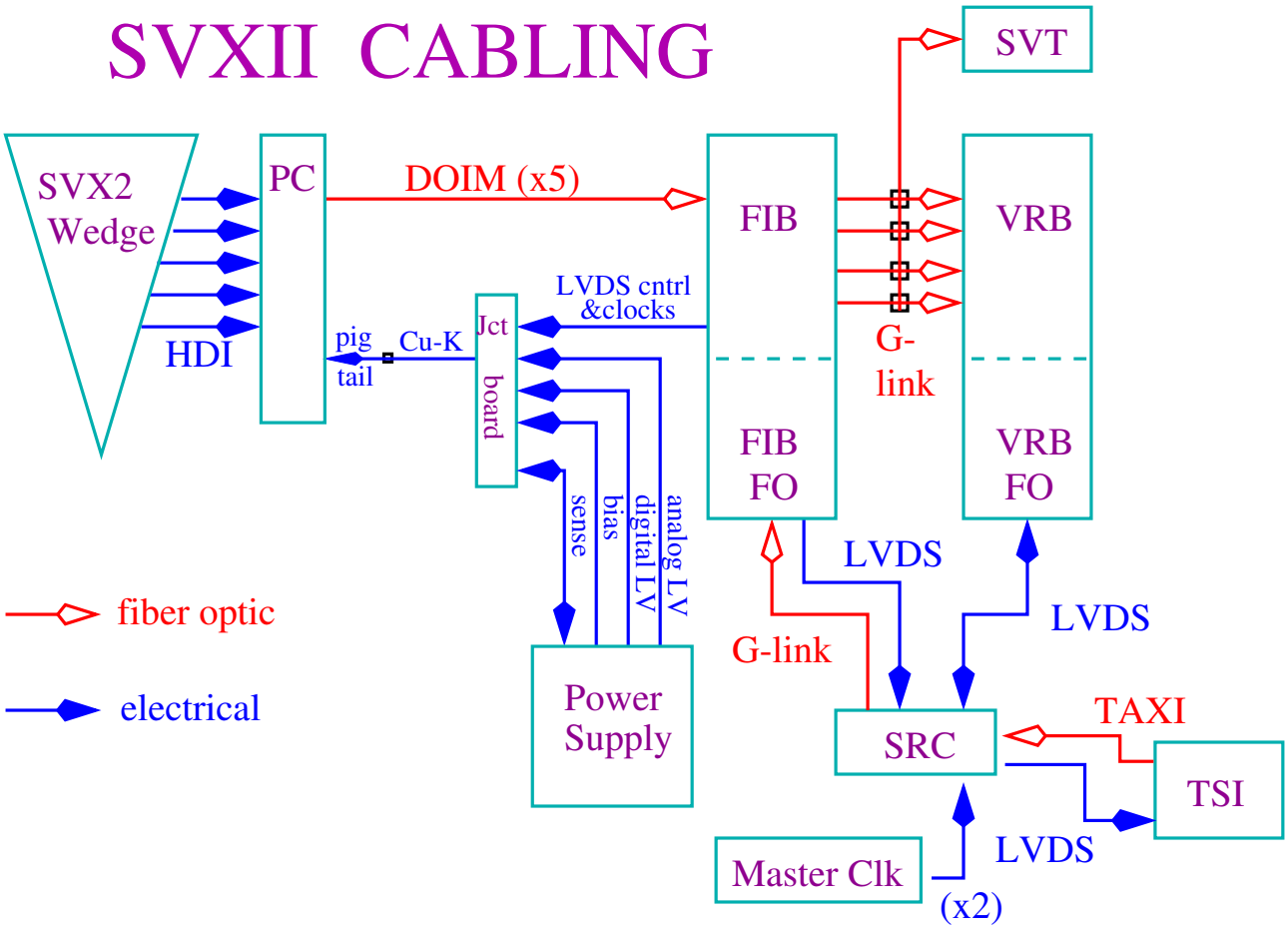

Figure 2: Cabling scheme for SVX II DAQ

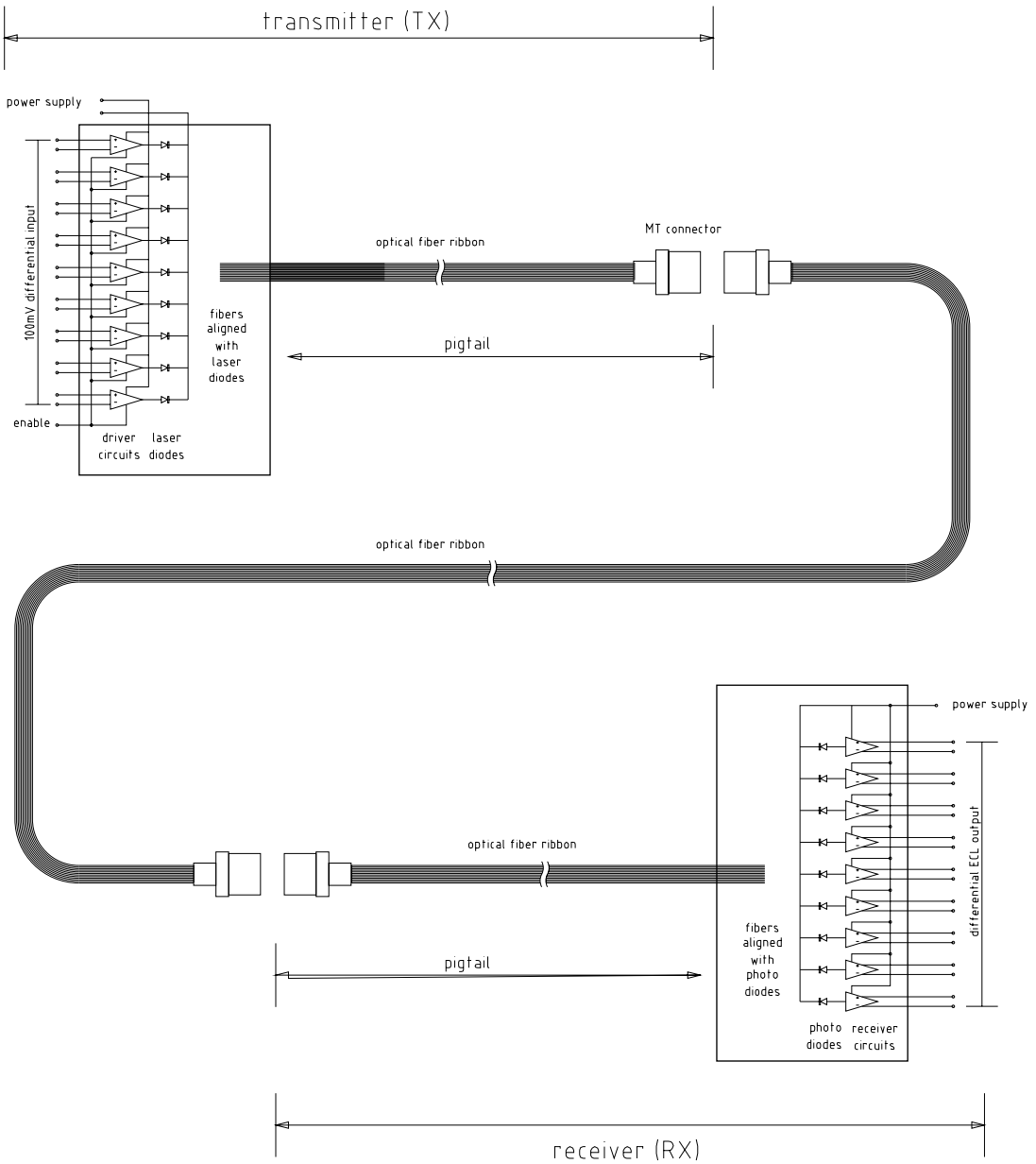

Figure 3: DOIM module and cable schematic.

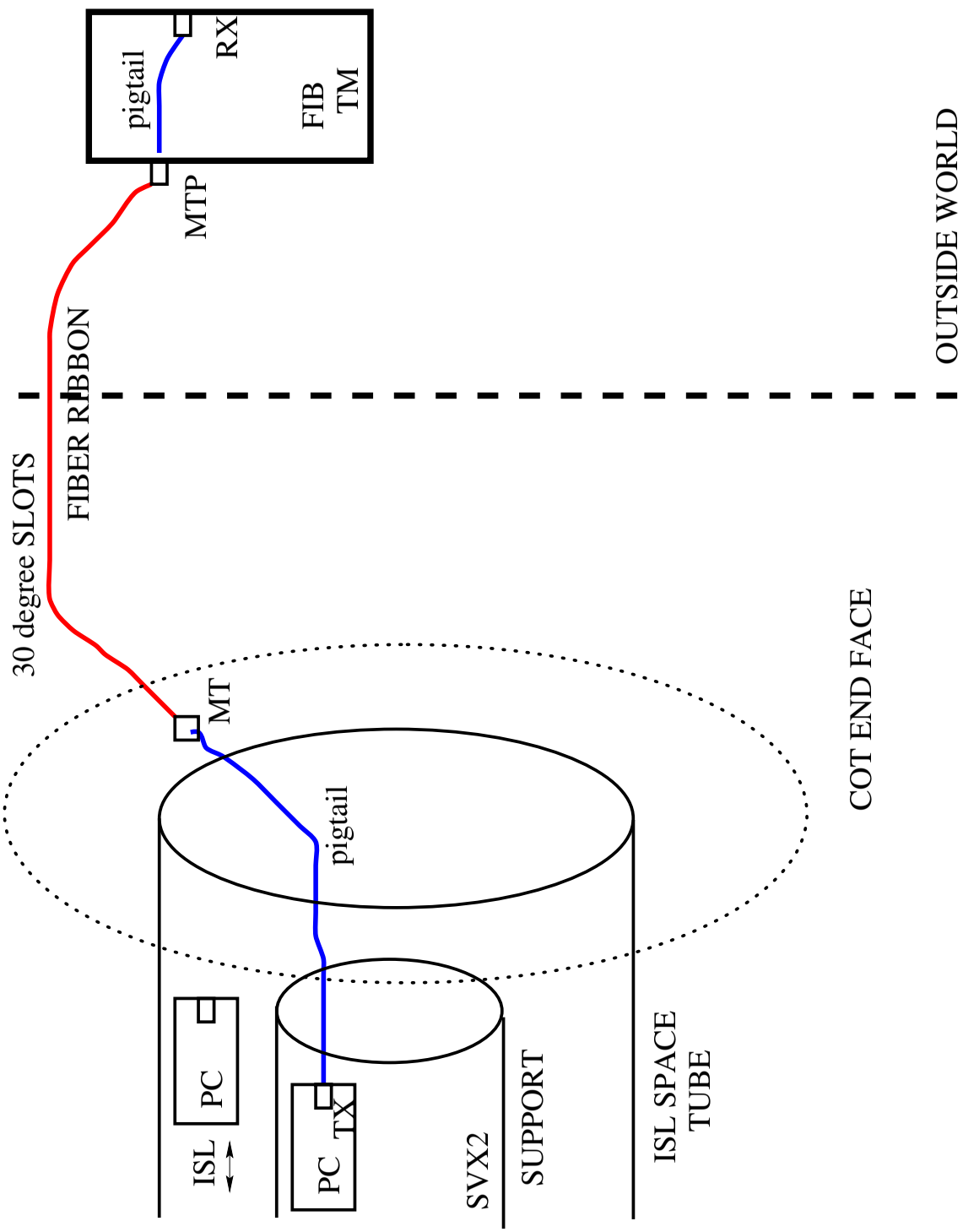

Figure 4: DOIM cabling scheme.

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======================================================================
SVXII and ISL G-Link cable specification

        Authors: M. Chertok and J.J. Schmidt
        Version 2.0      9/10/98

Purpose: to specify cable assemblies needed for the silicon G-link
systems so that the order can be sent out for bids.

LENGTHS AND QUANTITIES:

            SVX        ISL                  test
length   data ctrl  data ctrl  SRC  Spare  stand  TOTAL  name
----------------------------------------------------------------
 70'       36                   1     0      8      45   VRB
 80'       36                         6      0      42   SVT
300'       36   4    16   4           8      8      76   FIB

  "VRB" is split->VRB and SRC->split
  "SVT" is split->SVT
  "FIB" is FIB->split (SVX), FIB->VRB (ISL), and split->FIB FO
  For FIB spares: 4 to be pulled to splitter, 4 to VRB
Breakout lengths:
         name   breakout lengths
         ---------------------------------
           VRB     24",36"
           SVT     24",48"
           FIB     24",36"

       * Breakout point to be firmly reinforced with heat shrink
                or equivalent

length notes:
       * tolerance on length          +0" -12"
       * tolerance on breakout length +0" - 2"

CABLE TO BE USED:
        Optical Cable Corporation (OCC) Zero Halogen Core-locked
        6-channel (i.e. 6 fiber) breakout style cable.  50/125 um fiber.
        P/N B06-095Z-A3FB/1FC/900-R

CONNECTORS TO BE USED:
        All fiber ends to be terminated with low-loss (0.3 db typical
        loss or better) ST connectors using a
        ceramic ferrule, epoxy filled construction, and metal nut.  Acceptable
        connectors are Siecor, AMP, or Molex with a long boot for strain
        relief.  Prefer that connectors used for each cable assembly end
        be numbered 1 -> 6 corresponding to the 6 colors of the OCC
        PVC jacketing. (may not be available with all connectors).

PERFORMANCE:
        All acceptable cable assemblies shall have a total light loss
        of less than 1 dB @ 850 nm including the two connectors and
        length of fiber.  A test sheet must be included for each cable.
        Fermilab will retest the cables and must be able to obtain
        similar results.

LABELING:
        All cable assemblies shall have clear labelling on both ends
        (near breakout point) showing: vendor, date of manufacture,
        length, breakout length, and unique cable assembly identifier.
INSTALLATION HOOKS:
        Pulling "eye" to be provided along
        with cables for installation purposes.
ST CONNECTOR rubber caps:
        All ST connectors to be protected with rubber caps + 500 spare caps
SPOOLS:
        Cables must be delivered spooled with both connector ends
        accessible.
======================================================================
```


Figure 5: Glink cable specification.

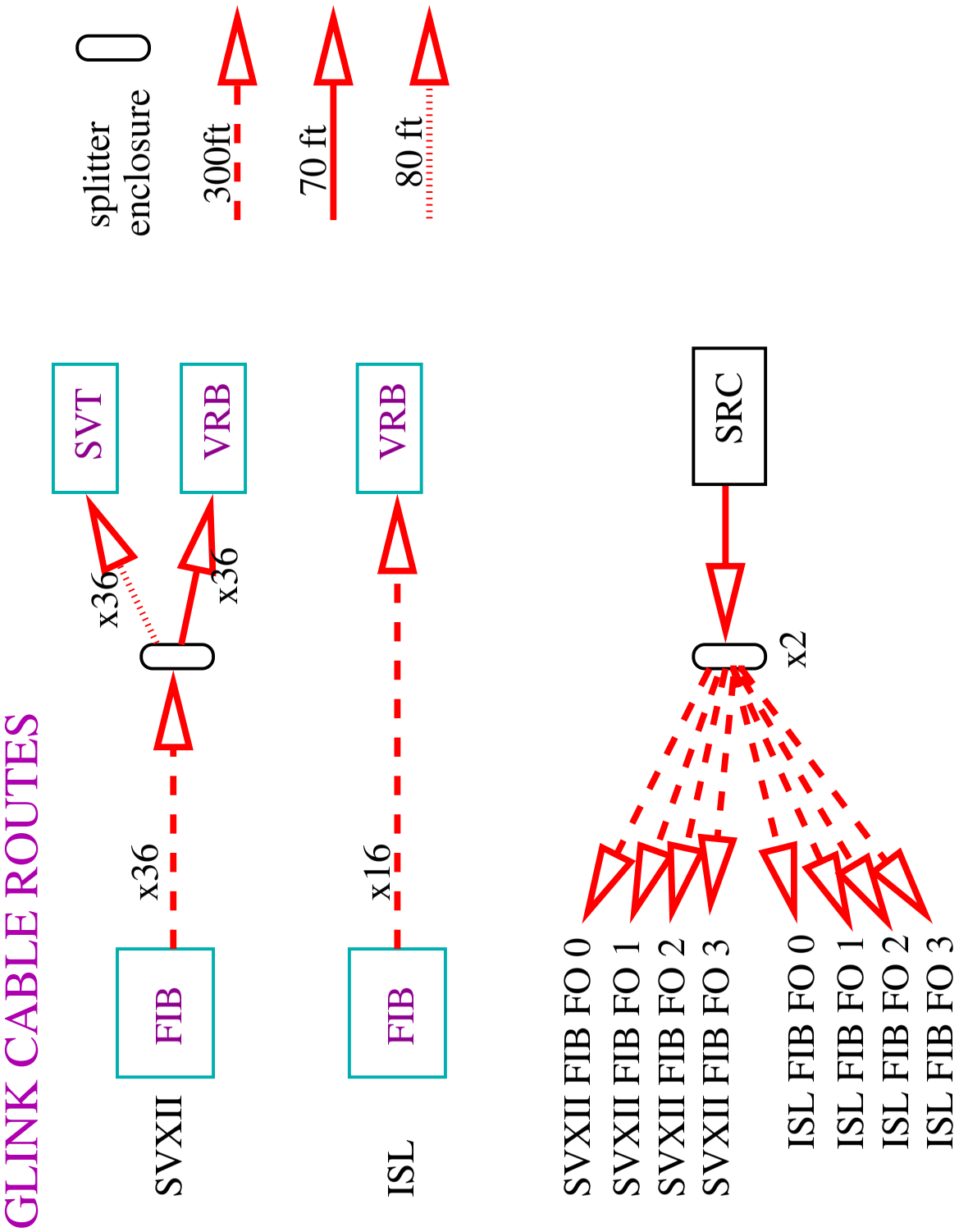

Figure 6: Glink cable routes.

Glink cable geometry and dimensions:

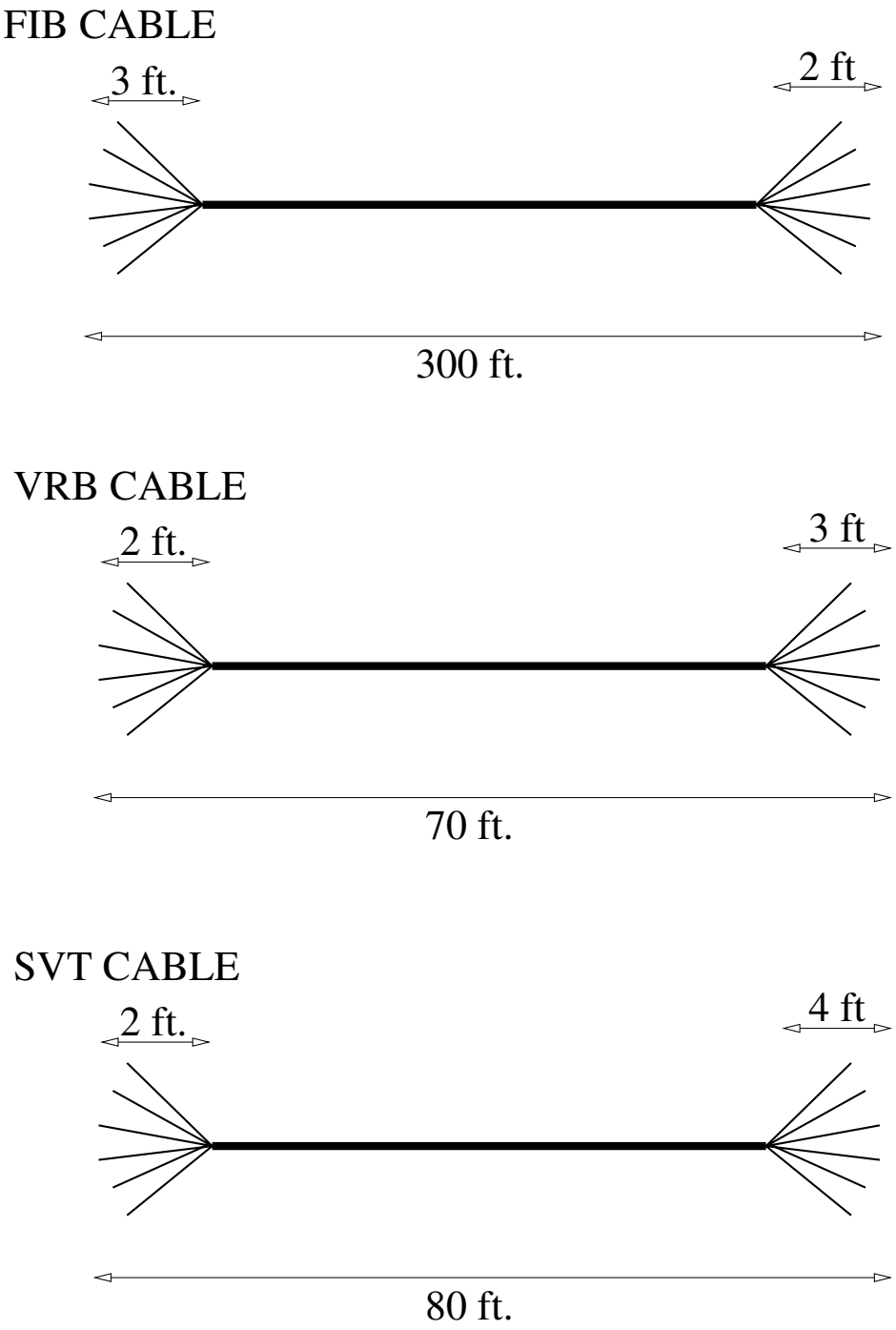

Figure 7: Glink cable dimensions.

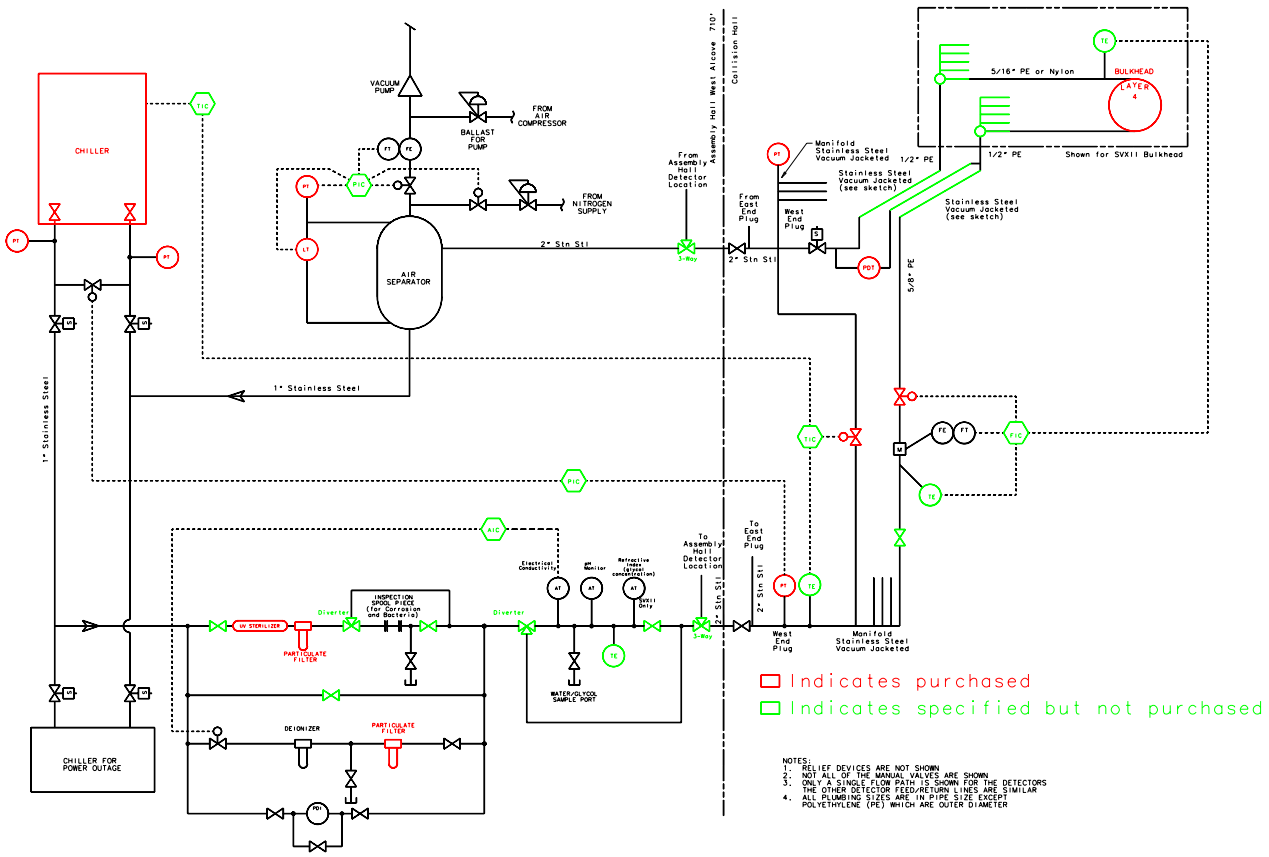

Figure 8: Schematic of the Cooling System. An updated version of this schematic is in progress.

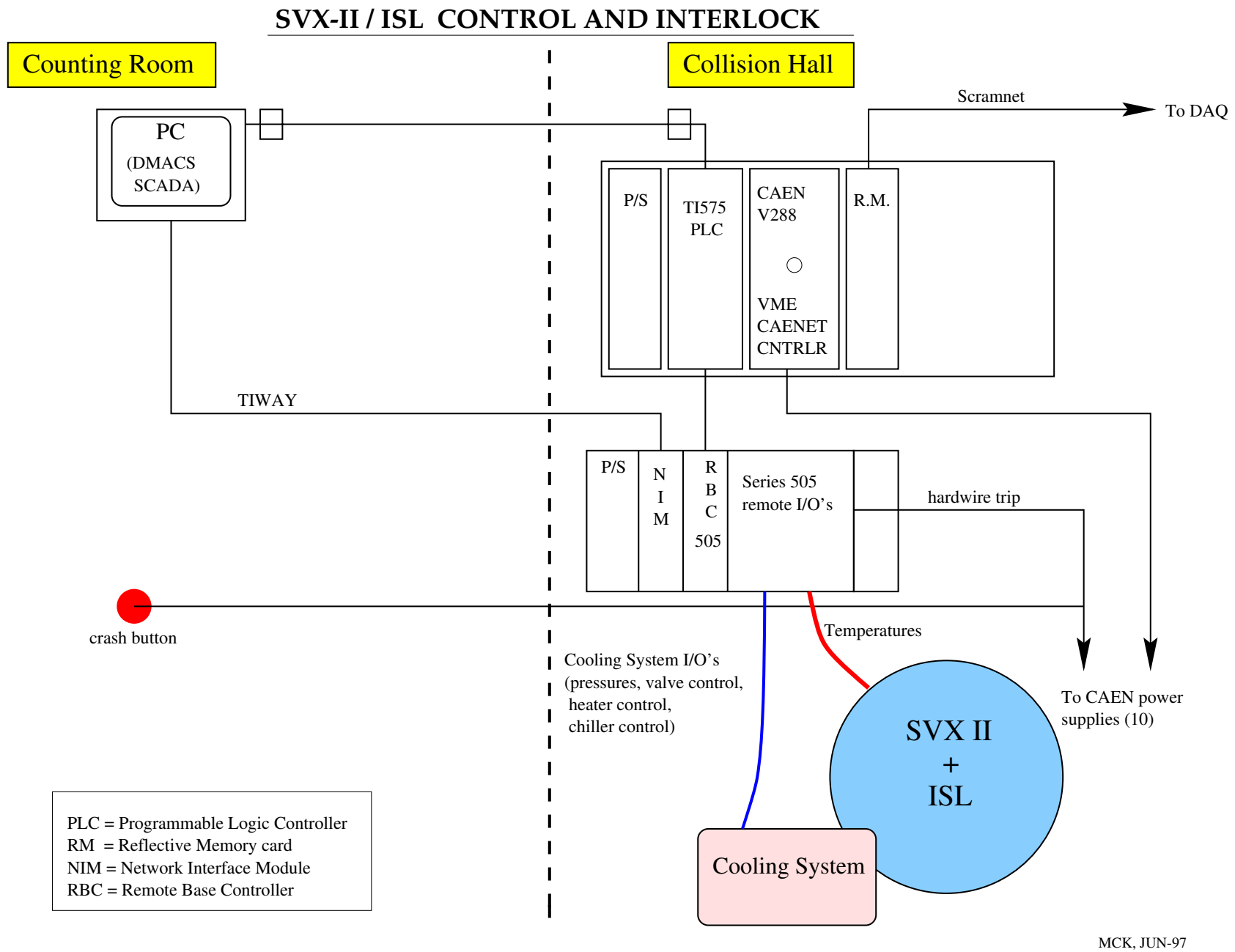

Figure 9: Schematic of the Interlock System

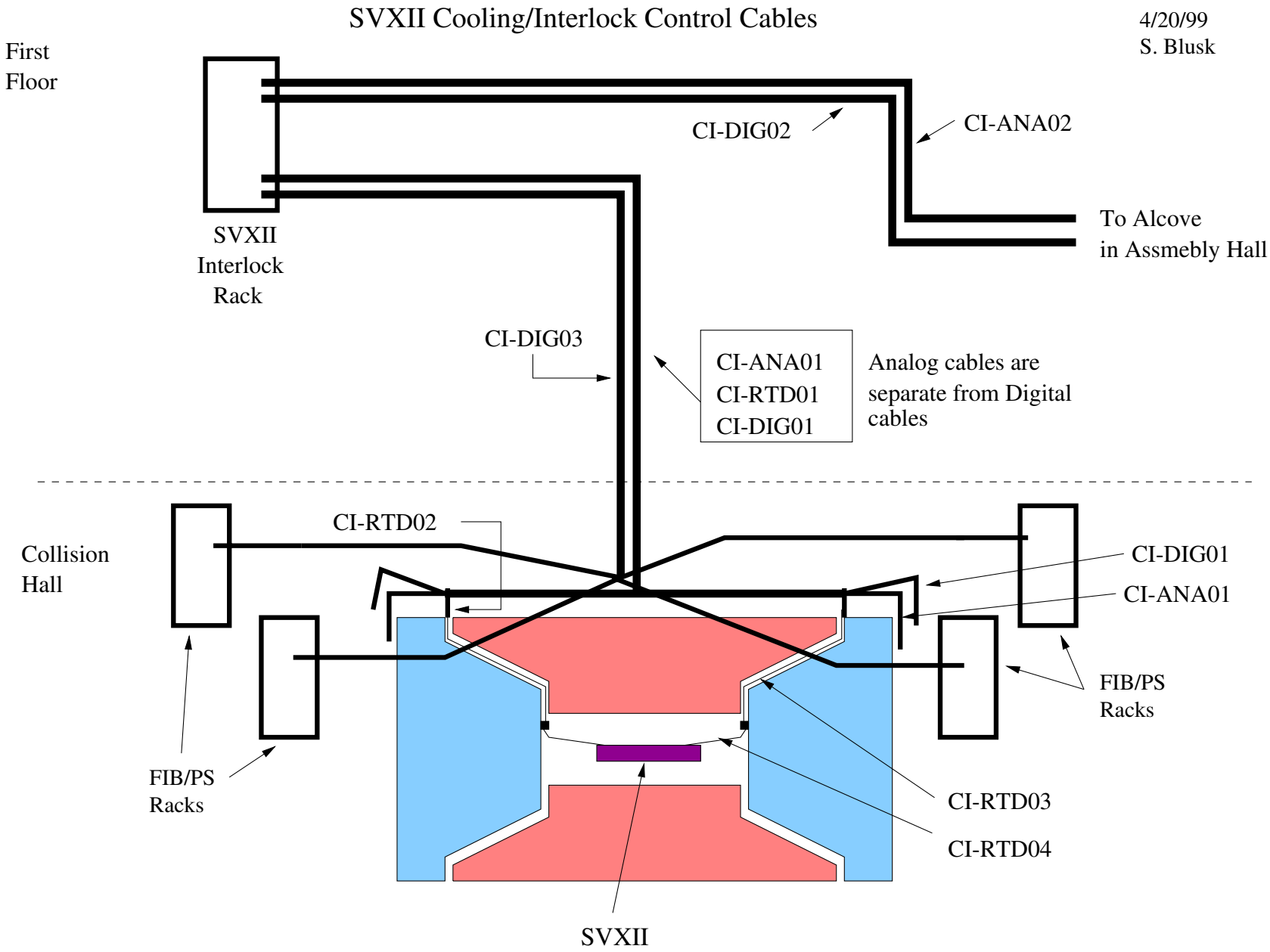

Figure 10: Schematic of the Cabling Layout

SVXII Analog Low Voltage Cable

- **Cable Description:**

Manufacturer: Amphenol
Cable type: Flat ribbon cable
Part number: 843-111-2214-024
Function: Supplies low voltage to analog section of SVX3 IC
Length: 60 ft.
Location_1: Power supply/FIB racks mounted on collision hall walls
Connector_1: Positronics ODD26, D-subminiature connector
Location_2: Just inside ISL spaceframe
Connector_2: Positronics ODD26
Comments: D type connector prevents incorrect mating

- **Fire Safety:**

Flame test rating: rated for 105 °C @ 300V
Insulation material: flame-retardant PVC
Jacket material: none

- **Electrical Considerations:**

Connector pin-out assignments:

Pin Number	Signal Name	Pin Number	Signal Name
1	UAV_1	10	AG_1
19	UAV_2	2	AG_2
11	UAV_2	20	AG_2
3	UAV_3	12	AG_3
21	UAV_3	4	AG_3
13	UAV_4	22	AG_4
5	UAV_4	14	AG_4
23	UAV_4	6	AG_4
15	UAV_5	24	AG_5
7	UAV_5	16	AG_5
25	UAV_5	8	AG_5
17	UAV_5	26	AG_5
9	SHIELD	18	GROUND

Power conductor ampacity: 3.3 Amps (connector pin capacity has been derated by 2/3 because there are multiple conductors for some output lines).
Maximum current per supply:

Supply Name	Maximum Voltage(V)	Maximum Current(A)	Number of lines	Current per line(A)
UAV_1	10.0	0.6	1	0.6
AG_1	0.0	0.6	1	0.6
UAV_2	10.0	0.9	2	0.45
AG_2	0.0	0.9	2	0.45

UAV_3	10.0	1.5	2	0.75
AG_3	0.0	1.5	2	0.75
UAV_4	10.0	1.5	3	0.5
AG_4	0.0	1.5	3	0.5
UAV_5	10.0	2.1	4	0.53
AG_5	0.0	2.1	4	0.53

(As the maximum current for any supply is below the rated maximum of the cable assembly, fusing of individual lines is not necessary.)
Power conductor overcurrent protection: fused at power supply (as well as hardware and software trip control).
High voltage conductor rating: 300V

- **Contact person:**

Mark W. Bailey, x8609, mwb@fnal.gov

SVXII Digital Low Voltage Cable

- **Cable Description:**

Manufacturer: Amphenol
Cable type: Flat ribbon cable
Part number: 843-111-2214-038
Function: Supplies low voltage to SVXII port card and digital section of SVX3 IC
Length: 60 ft.
Location_1: Power supply/FIB racks mounted on collision hall walls
Connector_1: Positronics ODD44, D-subminiature connector
Location_2: Just inside ISL spaceframe
Connector_2: Positronics ODD44
Comments: D type connector prevents incorrect mating

- **Fire Safety:**

Flame test rating: rated for 105 °C @ 300V
Insulation material: flame-retardant PVC
Jacket material: none

- **Electrical Considerations:**

Connector pin-out assignments:

Pin Number	Signal Name	Pin Number	Signal Name
1	DVDD1	16	DGND1
31	DVDD2	2	DGND2
17	DVDD3	32	DGND3
3	DVDD4	18	DGND4
333	DVDD4	4	DGND4
19	DVDD5	34	DGND5
5	DVDD5	20	DGND5
35	+5V_DOIM	6	DGNDP

21	+5V_DOIM	36	DGNDP
7	+5V_DOIM	22	DGNDP
37	+5V_DOIM	8	DGNDP
23	+5V_DOIM	38	DGNDP
9	+5V_DOIM	24	DGNDP
39	+2V_DOIM	10	DGNDP
25	+2V_DOIM	40	DGNDP
11	+2V_DOIM	26	DGNDP
41	+2V_DOIM	12	DGNDP
27	DTERM	42	DGNDP
13	SHIELD	28	GROUND
15,29,43	N/C	14,30,44	N/C

Power conductor ampacity: 3.3 Amps (connector pin capacity has been derated by 2/3 because there are multiple conductors for some output lines).
Maximum current per supply:

Supply Name	Maximum Voltage(V)	Maximum Current(A)	Number of lines	Current per line(A)
DVDD1	8.0	0.6	1	0.6
DGND1	0.0	0.6	1	0.6
DVDD2	8.0	0.9	1	0.9
DGND2	0.0	0.9	1	0.9
DVDD3	8.0	1.5	1	1.5
DGND3	0.0	1.5	1	1.5
DVDD4	8.0	1.5	2	0.75
DGND4	0.0	1.5	2	0.75
DVDD5	8.0	2.0	2	1.0
DGND5	0.0	2.0	2	1.0
+5V_DOIM	8.0	2.8	6	0.47
+2V_DOIM	3.5	1.7	4	0.43
DGNDP	0.0	1.1	10	0.11

(As the maximum current for any supply is below the rated maximum of the cable assembly, fusing of individual lines is not necessary.)
Power conductor overcurrent protection: fused at power supply (as well as hardware and software trip control).
High voltage conductor rating: 300V

- **Contact person:**

Mark W. Bailey, x8609, mwb@fnal.gov

SVXII High Voltage Bias Cable

- **Cable Description:**

Manufacturer: 3M
Cable type: Shielded and jacketed flat cable

Part number: 3517/20
Function: Supplies high voltage to reverse bias SVXII detector ladders.
Length: 60 ft.
Location_1: Power supply/FIB racks mounted on collision hall walls
Connector_1: 3M 8225-6000, D-subminiature connector
Location_2: Just inside ISL spaceframe
Connector_2: 3M 8225-6000
Comments: D type connector prevents incorrect mating

- **Fire Safety:**

Flame test rating: rated for 80 °C @ 300V
Insulation material: PVC
Jacket material: PVC

- **Electrical Considerations:**

Connector pin-out assignments:

Pin Number	Signal Name	Pin Number	Signal Name
1	DBZ1	14	DBP1
2	DBGND1	15	DPZ2
3	DBP2	16	DBGND2
4	DBZ3	17	DBP3
5	DBGND3	18	DBZ4
6	DBP4	19	DBGND4
7	DBZ5	20	DBP5
8	DBGND5	21	SHIELD
9	SHIELD	22	GROUND
10	GROUND	23	N/C
11,12,13	N/C	24,25	N/C

Power conductor ampacity: 1 Amp (estimated, as this is a power limited cable)
Maximum voltage and current requirements:

Supply Name	Maximum Voltage(V)	Maximum Current(mA)
DBPn	-125.0	5.0
DBZn	+125.0	5.0
DBGNDn	0.0	5.0

(All 5 layers have the same maximum voltages and currents. There is one set of 3 lines per layer.)
Power conductor overcurrent protection: fused at power supply (as well as hardware and software trip control).
High voltage conductor rating: 300V

- **Contact person:**

Mark W. Bailey, x8609, mwb@fnal.gov

SVXII Remote Sensing Cable

- **Cable Description:**

Manufacturer: 3M
Cable type: Shielded and jacketed twisted pair cable
Part number: 1785/20
Function: Provides remote voltage sensing to SVXII power supplies to enable dynamic voltage adjustment.
Length: 60 ft.
Location_1: Power supply/FIB racks mounted on collision hall walls
Connector_1: 3M 8225-6000, D-subminiature connector
Location_2: Just inside ISL spaceframe
Connector_2: 3M 8225-6000
Comments: D type connector prevents incorrect mating

- **Fire Safety:**

Flame test rating: rated for 80 °C @ 300V
Insulation material: PVC
Jacket material: PVC

- **Electrical Considerations:**

Connector pin-out assignments:

Pin Number	Signal Name	Pin Number	Signal Name
1	SDVDD1	14	SDGND1
2	SDVDD2	15	SDGND2
3	SDVDD3	16	SDGND3
4	SDVDD4	17	SDGND4
5	SDVDD5	18	SDGND5
6	S5VDOIM	19	SDGNDP
7	S2VDOIM	20	SDGNDP
8	SDTERM	21	SDGNDP
9	SHIELD	22	SHIELD
10	GROUND	23	GROUND
11,12,13	N/C	24,25	N/C

Power conductor ampacity: 1 Amp (estimated, as this is a power limited cable)
Power conductor overcurrent protection: sense lines are connected to load using (50Ω) current-limiting resistors. This would limit current to 160 mA in the event of a short in the sensing circuitry on the power supply.
High voltage conductor rating: 150V

- **Contact person:**

Mark W. Bailey, x8609, mwb@fnal.gov

SVXII FIB Timing Signal Cable

- **Cable Description:**

Manufacturer: 3M
Cable type: Shielded and jacketed high density flat cable
Part number: 90101/50
Function: Provides LVDS timing signals from the SVXII FIB transition module.
Length: 60 ft.
Location_1: Power supply/FIB racks mounted on collision hall walls
Connector_1: Amp Amplimite 749721-5 0.05x0.10
Location_2: Just inside ISL spaceframe
Connector_2: Amp Amplimite 749721-2 0.05x0.10
Comments: Cable carries signals from FIB to 2 port cards. At the junction board end, the cable is split and terminated with two separate connectors. D (trapezoidal) shape of connector prevents incorrect mating.

- **Fire Safety:**

Flame test rating: rated for 75 °C @ 100V
Insulation material: Thermoplastic Elastomer (TPE)
Jacket material: PVC

- **Electrical Considerations:**

Connector pin-out assignments:

Pin Number	Signal Name	Pin Number	Signal Name
1	ICFE_CLKH	2	ICFE_CLKL
3	C_CLK	4	C_CLK*
5	C_DATA	6	C_DATA*
7	C_C0	8	C_C0*
9	C_C1	10	C_C1*
11	C_C2	12	C_C2*
13	C_C3	14	C_C3*
15	C_C4	16	C_C4*
17	ICBE_CLKL	18	ICBE_CLKH
19	C_L1A	20	C_L1A*
21	CPIPE_RD2*	22	CPIPE_RD2
23,25	n/c	24,26	n/c

Power conductor ampacity: 1 Amp (estimated, as this is a power limited cable)
Power conductor overcurrent protection: n/a
High voltage conductor rating: 100V

- **Contact person:**

Mark W. Bailey, x8609, mwb@fnal.gov

SVXII Junction Board Cable Connector

- **Board Description:**

Manufacturer: Custom designed at UNM. Vendor for fabrication TBD.
Board type: Multi-layer PCB
Part number: n/a
Function: Merges power and timing signals from the SVXII power supplies and FIB transition module onto the SVXII Long Cu-Kapton cable
Dimensions: approximately 2.5 x 3.5 inches (TBD).
Location_1: Just inside the ISL space frame.
Connector_1: 5 input connectors and 2 output connectors. See the technical design specification for a complete description.
Comments: Keyed and/or D shape connectors prevent incorrect connector mating.

- **Fire Safety:**

Flame test rating:
Substrate Material: G10

- **Electrical Considerations:**

Note: The specification of this board has been provided to the committee, and can be found on the web at http://www-cdf.fnal.gov/upgrades/svxii/power/junction2.html.
The design of traces on the board exceeds the current carrying abilities of the connector pins. In cases where the connector receptacle on the junction board supports less current than the cable conductors, the maximum current listed for the respective cable has been adjusted to reflect this.
Connector pin-out assignments: (See specification for details)
Power conductor overcurrent protection: fused at power supply (as well as hardware and software trip protection).
High voltage conductor rating: High-voltage traces are separated by at least 0.010 inches from all other traces. This will withstand a voltage of up to 500 V, per IPC guidelines. Other traces are separated by at least 0.005 inches, which will withstand up to 100 V.

- **Contact person:**

Mark W. Bailey, x8609, mwb@fnal.gov

SVXII Long Cu-Kapton Cable

- **Cable Description:**

Manufacturer: Custom designed at Fermilab. Vendor for fabrication TBD.
Cable type: Cu-Kapton flex cable
Part number: n/a
Function: Delivers power and timing signals from the SVXII junction board to the SVXII pigtail cable.
Length: 4 ft.
Location_1: At junction board, just inside ISL spaceframe.
Connector_1: Two (2) Berg Electronics 91910-21141, high-density “Conan” connectors

Location_2: SVXII pigtail cable
Connector_2: Two Berg Conan connectors, 91910-21141
Comments: Keyed connector prevents incorrect mating.

- **Fire Safety:**

Flame test rating: service temperature rating of 300 °C; negligible burning rate per ASTM 635.
Insulation material: Kapton (polyimide)
Jacket material: none

- **Electrical Considerations:**

Note: This cable follows the design specification of the pigtail cable, which has been provided to the committee, and can be found on the web at http://www-cdf.fnal.gov/upgrades/svxii/power/pigtail_spec.html. Relative to the pigtail design, this cable is twice as long, but all current-carrying traces have been widened by factors of 5 to 9. Thus this cable has an even higher electrical safety margin than the pigtail cable.
Connector pin-out assignments:
Connector 1:

Pin Number	Signal Name	Pin Number	Signal Name
1	SHIELD	2	ICFE_CLKH
3	ICFE_CLKL	4	C_CLK
5	C_CLK*	6	C_DATA
7	C_DATA*	8	C_C0
9	C_C0*	10	C_C1
11	C_C1*	12	C_C2
13	C_C2*	14	C_C3
15	C_C3*	16	C_C4
17	C_C4*	18	ICBE_CLKL
19	ICBE_CLKH	20	C_L1A
21	C_L1A*	22	CPIPE_RD2*
23	CPIPE_RD2	24	+5V_DOIM
25	+2V_DOIM	26	+5V_DOIM
27	+2V_DOIM	28	+5V_DOIM
29	DGNDP	30	DGNDP
31	DGND5	32	DVDD5
33	DGND4	34	DVDD4
35	DGND3	36	DVDD3
37	DGND2	38	DVDD2
39	DGND1	40	DVDD1
41	N/C		

Connector 2:

Pin Number	Signal Name	Pin Number	Signal Name
1	AG_1	2	UAV_1

3	AG_2	4	UAV_2
5	AG_3	6	UAV_3
7	AG_3	8	UAV_3
9	AG_4	10	UAV_4
11	AG_4	12	UAV_4
13	AG_5	14	UAV_5
15	AG_5	16	UAV_5
17	AG_5	18	UAV_5
19	N/C	20	N/C
21	DBGND1	22	DBP1
23	DBZ1	24	N/C
25	DBGND2	26	DBP2
27	DBZ2	28	N/C
29	DBGND3	30	DBP3
31	DBZ3	32	N/C
33	DBGND4	34	DBP4
35	DBZ4	36	N/C
37	DBGND5	38	DBP5
39	DBZ5	40	N/C
41	N/C		

Power conductor ampacity: 0.7 Amp (the connector capacity has been derated by 2/3, because there are multiple pins for some output lines).

Maximum current requirements:

		Trace Widths			
Name	Trace	Maximum	Voltage	Number of	Current
	Width	Current (mA)	Drop (mV)	Conan Pins	Margin
+5V_DOIM	357	1800	50	3	67%
+2V_DOIM	217	1100	50	2	82%
DVDD5	45	240	50	1	317%
DVDD4	35	180	50	1	456%
DVDD3	35	180	50	1	456%
DVDD2	25	120	50	1	733%
DVDD1	15	90	50	1	1011%
DGNDP	140	700	50	2	186%
UAV_5	225	1120	50	3	168%
UAV_4	162	800	50	2	150%
UAV_3	162	800	50	2	150%
UAV_2	99	480	50	1	108%
UAV_1	63	320	50	1	213%

Power conductor overcurrent protection: fused at power supply (as well as hardware and software trip protection).

High voltage conductor rating: High-voltage traces are separated by at least 0.015 inches from all other traces. This will withstand a voltage of up to 300 V, per IPC guidelines. Other traces are separated by at least 0.005 inches, which will withstand up to 100 V.

- **Contact person:**

Mark W. Bailey, x8609, mwb@fnal.gov

SVXII Port Card Pigtail Cable

- **Cable Description:**

Manufacturer: Custom designed at Fermilab. Vendor for fabrication TBD.
Cable type: Cu-Kapton flex cable
Part number: n/a
Function: Delivers power and timing signals from the SVXII Long Cu-Kapton cable to the SVXII port card.
Length: 24 in.
Location_1: Between 4 and 15 inches from end of SVXII detector.
Connector_1: Two (2) Berg Electronics 91910-21141, high-density "Conan" connectors
Location_2: SVXII port card
Connector_2: soldered onto port card
Comments: Keyed connector prevents incorrect mating.

- **Fire Safety:**

Flame test rating: service temperature rating of 300 °C; negligible burning rate per ASTM 635.
Insulation material: Kapton (polyimide)
Jacket material: none

- **Electrical Considerations:**

Note: The specification of this cable has been provided to the committee, and can be found on the web at http://www-cdf.fnal.gov/upgrades/svxii/power/pigtail_spec.html.
Connector pin-out assignments:
Connector 1:

Pin Number	Signal Name	Pin Number	Signal Name
1	SHIELD	2	ICFE_CLKH
3	ICFE_CLKL	4	C_CLK
5	C_CLK*	6	C_DATA
7	C_DATA*	8	C_C0
9	C_C0*	10	C_C1
11	C_C1*	12	C_C2
13	C_C2*	14	C_C3
15	C_C3*	16	C_C4
17	C_C4*	18	ICBE_CLKL
19	ICBE_CLKH	20	C_L1A
21	C_L1A*	22	CPIPE_RD2*
23	CPIPE_RD2	24	+5V_DOIM
25	+2V_DOIM	26	+5V_DOIM

27	+2V_DOIM	28	+5V_DOIM
29	DGNDP	30	DGNDP
31	DGND5	32	DVDD5
33	DGND4	34	DVDD4
35	DGND3	36	DVDD3
37	DGND2	38	DVDD2
39	DGND1	40	DVDD1
41	N/C		

Connector 2:

Pin Number	Signal Name	Pin Number	Signal Name
1	AG_1	2	UAV_1
3	AG_2	4	UAV_2
5	AG_3	6	UAV_3
7	AG_3	8	UAV_3
9	AG_4	10	UAV_4
11	AG_4	12	UAV_4
13	AG_5	14	UAV_5
15	AG_5	16	UAV_5
17	AG_5	18	UAV_5
19	N/C	20	N/C
21	DBGND1	22	DBP1
23	DBZ1	24	N/C
25	DBGND2	26	DBP2
27	DBZ2	28	N/C
29	DBGND3	30	DBP3
31	DBZ3	32	N/C
33	DBGND4	34	DBP4
35	DBZ4	36	N/C
37	DBGND5	38	DBP5
39	DBZ5	40	N/C
41	N/C		

Power conductor ampacity: 0.7 Amp (the connector capacity has been derated by 2/3, because there are multiple pins for some output lines).

Maximum current requirements:

			Trace Widths					
Name	Trace	Resistance	Maximum	Voltage	Number of	Current	Target	Power
	Width	(ohms)	Current (mA)	Drop (mV)	Conan Pins	Margin	Resistance	(mW)
+5V_DOIM	51	0.111	1800	200	3	67%	0.111	360
+2V_DOIM	31	0.182	1100	200	2	82%	0.182	220
DVDD5	9	0.625	240	150	1	317%	0.625	36
DVDD4	7	0.833	180	150	1	456%	0.833	27
DVDD3	7	0.833	180	150	1	456%	0.833	27
DVDD2	5	1.250	120	150	1	733%	1.250	18
DVDD1	5	1.667	90	150	1	1011%	1.667	14
DGNDP	20	0.286	700	200	2	186%	0.286	140
UAV_5	25	0.223	1120	250	3	168%	0.223	280

UAV_4	18	0.313	800	250	2	150%	0.313	200
UAV_3	18	0.313	800	250	2	150%	0.313	200
UAV_2	11	0.521	480	250	1	108%	0.521	120
UAV_1	7	0.781	320	250	1	213%	0.781	80
							Total power	2723

Power conductor overcurrent protection: fused at power supply (as well as hardware and software trip protection).
High voltage conductor rating: High-voltage traces are separated by at least 0.015 inches from all other traces. This will withstand a voltage of up to 300 V, per IPC guidelines. Other traces are separated by at least 0.005 inches, which will withstand up to 100 V.

- **Contact person:**

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SVXII HDI Cables

- **Cable Description:**

Manufacturer: Custom designed at UNM and LBL. Fabricated by Hadco/Dynaflex. Assembled at LBL and Texas Tech.
Cable type: Cu-Kapton flex cable with 34(32) AWG wires for power lines.
Part number: n/a
Function: Delivers power and timing signals from the SVXII port card to each of the SVXII ladder hybrids.
Length: 4 to 9 inches.
Location_1: SVXII port card
Connector_1: Two (2) Elco Microleaf #10-5087-030 connectors
Location_2: SVXII ladder hybrids
Connector_2: soldered onto hybrid
Comments: Keyed connector prevents incorrect mating.

- **Fire Safety:**

Flame test rating: tested at LBL 100 °C with stiffener and glued with epoxy. No delamination observed.
Insulation material: Kapton (polyimide)
Jacket material: none

- **Electrical Considerations:**

Connector pin-out assignments:
Connector 1:

Pin Number	Signal Name	Pin Number	Signal Name
1	DVDD	2	DGND
3	BEMDE	4	CHMDE
5	CAL/SR	6	FEMDE
7	TRL1A	8	GND

9	PPRD1	10	PPRD2
11	TN	12	PARST
13	VCAL	14	BN
15	DBGND	16	GND
17	GND	18	GND
19	AVDD	20	AVDD
21	AVDD	22	AVDD
23	N/C	24	N/C
25	DBP2	26	DBZ2
27	N/C	28	N/C
29	DBP1	30	DBZ1

Connector 2:

Pin Number	Signal Name	Pin Number	Signal Name
1	N/C	2	N/C
3	BUS7	4	BUS7*
5	BUS6	6	BUS6*
7	BUS5	8	BUS5*
9	BUS4	10	BUS4*
11	BUS3	12	BUS3*
13	BUS2	14	BUS2*
15	BUS1	16	BUS1*
17	BUS0	18	BUS0*
19	OBDV	20	OBDV*
21	BECK	22	BECK*
23	FECK	24	FECK*
25	DVDD	26	DVDD
27	DGND	28	DVDD
29	DGND	30	DGND

Power conductor ampacity: 0.3Amp (the connector capacity has been derated by 2/3, because there are multiple pins for some output lines).
Power conductor overcurrent protection: fused at power supply (as well as hardware and software trip protection).
High voltage conductor rating: High-voltage traces are separated by at least 0.015 inches from all other traces. This will withstand a voltage of up to 300 V, per IPC guidelines. Other traces are separated by at least 0.005 inches, which will withstand up to 100 V. Connector rating is 50 V, so pins 23,24,27,28 have been left unoccupied. Tests at LBL showed no leakage over 24 hours for a voltage difference of 200 V.

- **Contact persons:**

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