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ATLAS SCT Grounding Plans

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This note describes the current plans and thinking of the ATLAS SCT for grounding its electrical system. It should not be taken as a completed plan but rather the current status of plans at this time. These plans are a result of discussions between many members of the SCT community who have experience building and running silicon micro-strip detectors in various experiments and ATLAS beam tests. The basics of these plans are currently being implemented in the designs of power supplies and cables.

The ATLAS SCT consists of 4088 detector modules. In principle, each module is treated as electrically separate and isolated from each other. This is not exactly true but nearly true in all aspects. This independence not only provides the simplest electrical system in terms of cross-talk, ground loops and general interference but also limits the loss in detector coverage for a given single failure. There is some added expense to this approach but the SCT community believes that is necessary to enhance the reliability and maintainability of the system.

Each detector module will have a separate set of supplies and separate cabling. This is to afford maximum modular control and minimum dead detector area should one unit fail. It also allows individual module monitoring from a remote point without need for on-detector monitors. That is, each detector module's power supply will monitor the voltage and the current draw for each voltage level. The power supplies will be located in the Service Area outside of the radiation area with long cables feeding into the detector region. Another option has been studied to put the detectors in the collider hall next to the ATLAS detector. This would save the cost of long cable runs. However, it would require all the components of the power supplies to be radiation tolerant. This would require a considerable amount of development which is now inconsistent with the SCT schedule and R&D funds available.

Cabling for each DC channel will be as wire pairs (i.e. unique return line for each channel). The cabling from the power supplies to the detector will be bundles of twisted pair, one bundle per module and the cabling inside the detector volume will be Kapton/Aluminium tapes with the power and return lines configured as parallel conductors on opposite sides of the Kapton. Thus the power transmission will appear as low impedance transmission lines. This will maximize the coupling between each power lead and its return and minimize the coupling to outside interference.

All DC channels will either float at the power supplies or be optionally referenced to Earth via high impedance resistors. Separate DC channels for each module (e.g. Analogue and Digital Power) will have their return lines tied together with resistors at the detector module. The reference or return lines for adjacent modules may be tied together via resistors. The need for this is discussed below. (See Figure 1 for a diagram of the power supply and module interconnects.)

Data transmission from each module and timing, trigger and control (TTC) signals to each module are handled by low speed fibre optics (three fibres per module) thus providing complete electrical isolation between the module and the off-detector electronics. The only other electrical connection to the outside environment is a temperature probe (one per module) which will again float being fed to the outside via a pair of wires. Thus each module will float relative to each other module and relative to earth. There is, however, one exception to this. The TTC signals for each module, after they are converted from optical to electrical at the module, will be fed to the adjacent module for it to use optionally in place of its primary TTC signals. This sharing of TTC signals across modules provides for redundancy should one TTC link fail but also facilitates module-to-module synchronization. All of these electrical TTC signals which are shared between adjacent modules are fully differential, low voltage swing signals (LVS standard) which will minimize any coupling between modules and not return any DC current across module boundaries. However, it is important to keep the reference points of adjacent modules equal to within a level manageable by the low voltage swing receivers of the TTC signals. This can be accommodated by connections between modules which are high impedance in the frequency range the detector signals but still capable of maintaining the same DC reference point.

There is no need for direct connections to Earth anywhere in SCT except possibly for safety reason (i.e. to make sure that no DC voltage levels are attained which could be dangerous if accidentally touched or shorted to something or someone). These safety ties to Earth can be accomplished through high impedance resistors, probably back at the power supplies.

It is planned to have an electrical shield (Faraday cage) separating the SCT from the TRT. It is not clear now to what to reference or attach this shield since the SCT defines no Earth or "SCT-Common" potential. This needs to be studied more, but possibly this shield should be referenced to some TRT common potential.

The affects of inter-module connections are still being studied. This includes the TTC connections between adjacent modules mentioned above but also includes other capacitive or parasitic couplings such as capacitive couplings to cooling pipes or other support structures.

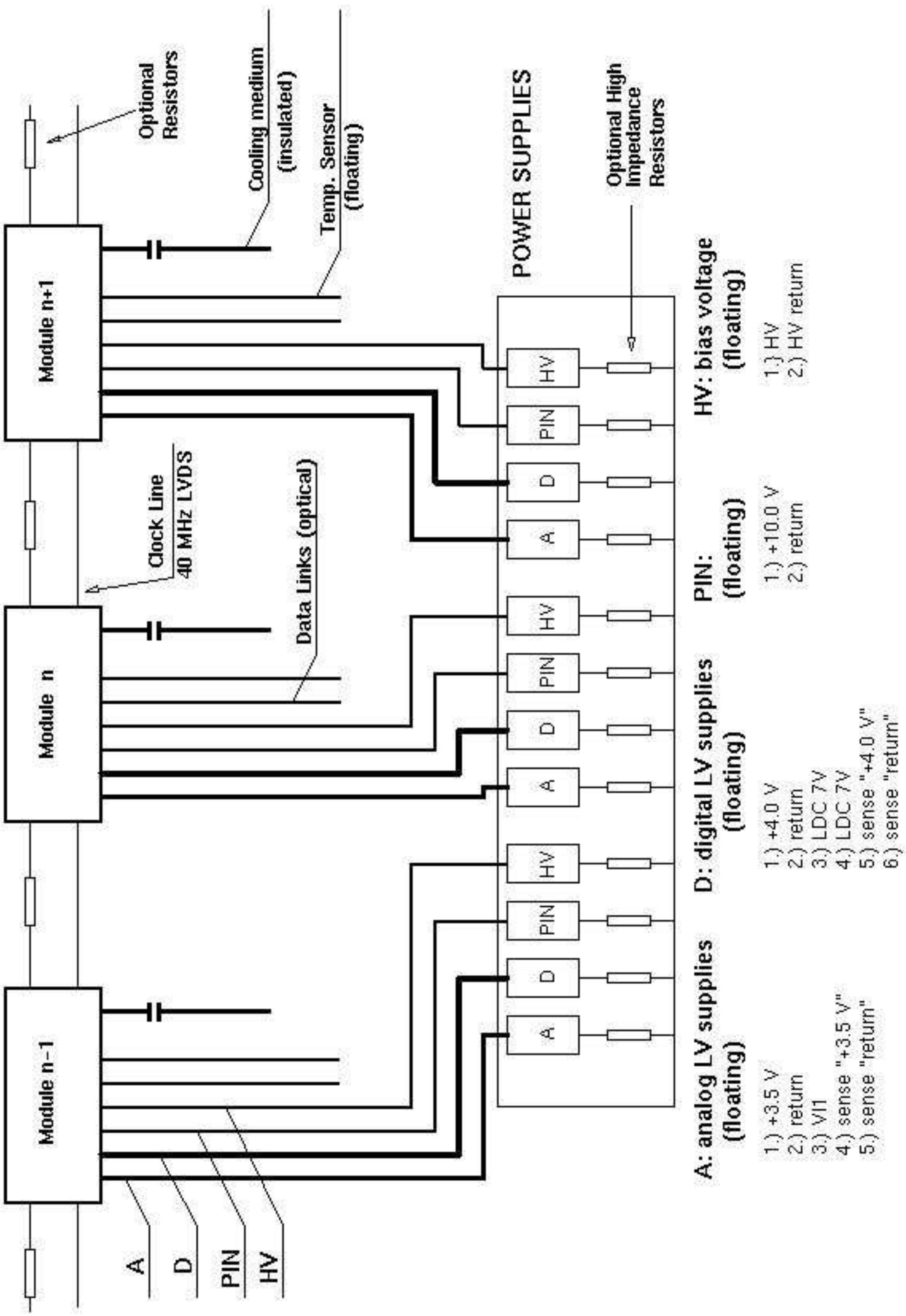

Figure 1: Diagram of SCT Electrical Interconnects