



HAWC CDR

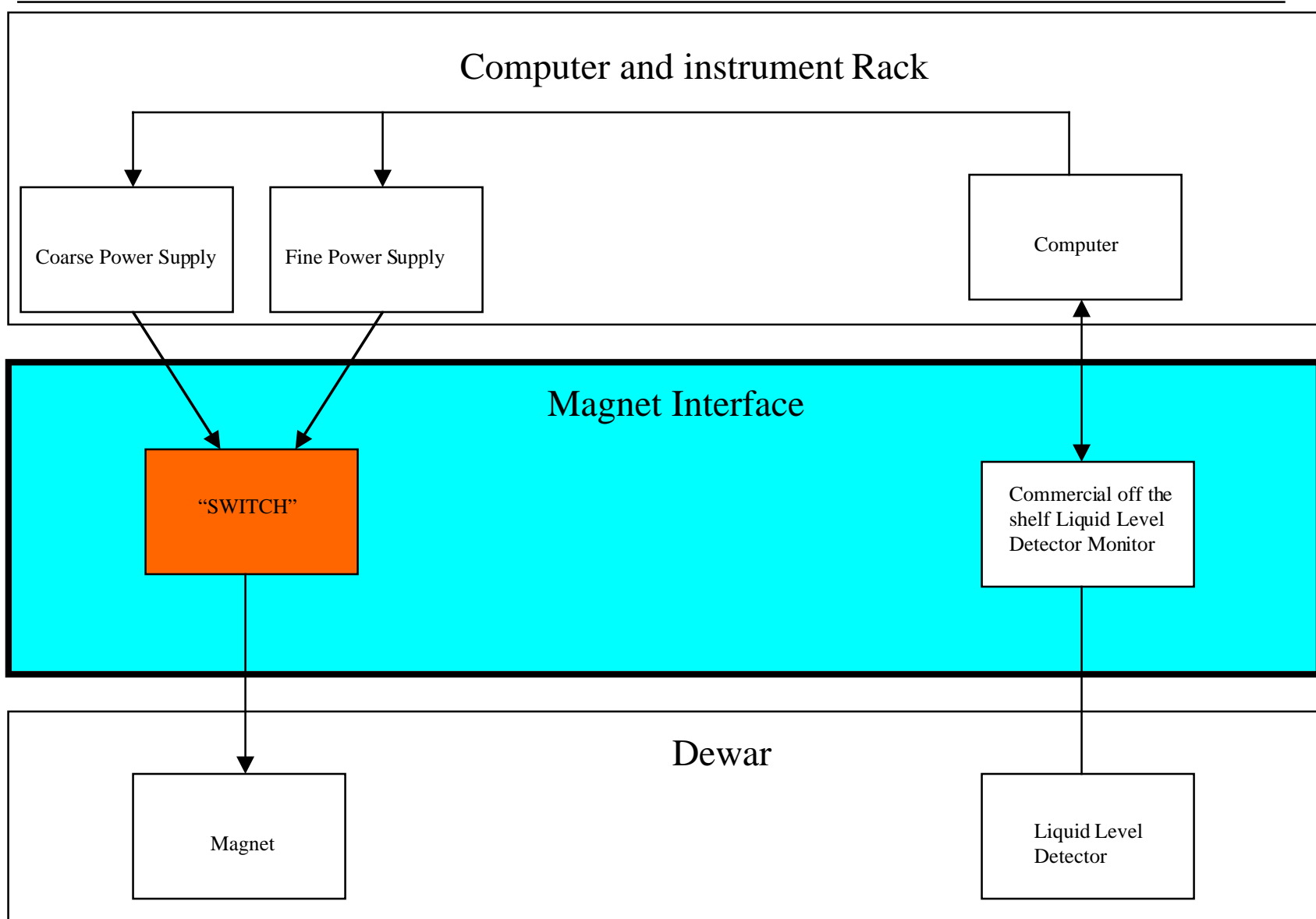
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ADR Magnet Electronics

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Magnet Interface Diagram



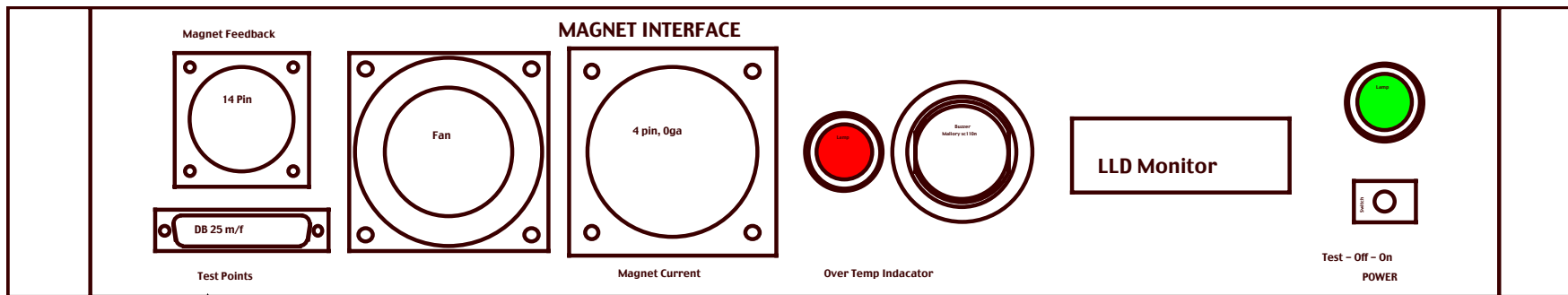
Magnet Interface Picture

Magnet voltage inputs

Cooling fan

Connector for magnet leads

Power switch

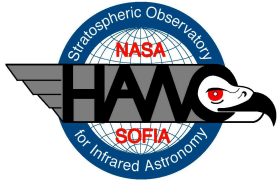


Test Points

Overtemp alarm

Liquid level readout





Magnet Interface Requirements



- ADR operations require two power supplies
 - During recycling, a high-current supply generates a high magnetic field to magnetize the salt pill
 - During operations, a precision (low-) current supply maintains a stable temperature
- Magnet Interface Box
 - Must seamlessly transition from one power supply to the other
 - Maximum magnet current is 55 Amps
 - Switching between supplies occurs at less than 3 A current
 - Voltage drop should be less than 2 V at maximum current
 - Maximum magnet charging voltage is 3 V
 - Power supply voltage is ± 5 V
 - Must be a rack mount unit, less than 4” high
 - Safety and Robustness
 - Must accept possible failures by other systems
 - If a failure happens, must not damage equipment or personnel
 - Monitors Liquid Helium (LHe) Level



Design Approach

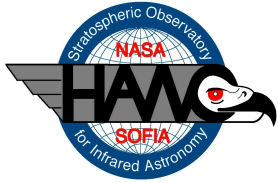


- **Magnet Interface Box**

- Current is switched passively using diodes
- Current limiting is performed by the power supplies
 - 55 Amps is the physical limit of the magnet; over current will result in quench
 - 100 Amps is the limit of the high-current power supply
 - Lower limits can be programmed via GPIB or front-panel interface
- Interface box circuitry and external connectors are designed for 150 Amps
 - Diodes that handle currents in the 50-150 Amp range are all of similar size and cost
 - Over design adds safety and robustness with no performance or cost penalties
 - Allows design to be used with future magnet/ADR systems
- Internal box temperature is thermostatically controlled by a fan
 - Threshold of 50 °C is expected only for currents above 50 Amps

- **Liquid Level Detector Readout**

- Uses COTS electronics for reading out a superconducting level sensor (American Magnetics Model 135)
- Repackaged into available space in the Interface box



Design



- **Basic operation**

- Power supply outputs are “summed” by diodes
- Diodes prevent negative current flow from either power supply
- Each supply is effectively switched out of the circuit when its output voltage is sufficiently negative
 - Threshold is 0 to ~ -0.5 V, depending on current
 - -4 V is applied when a supply is to be switched out
- Operating both power supplies as voltage sources allows current to be transferred from one to the other “on the fly”

- **Expected voltage drops and power dissipation at 55 Amps**

- Total voltage drop of less than 1 V
 - 0.65 V across diodes and connectors
 - 0.25 V across 25 feet of magnet cable
- Diodes will dissipate up to 22 Watts
 - Internal temperature may reach 50 °C prior to active cooling by fan



Test Results



- **Current Handling**

- Tested successfully with 100 Amps (without magnet)
 - Heat sink remained below 50 °C after 15 minutes with no active cooling
- Total voltage drop of <1 V @ 100 Amps
 - 25 feet of lead cable (50 feet round trip) produced 0.5 Volt drop
 - All connections and internal components produced < 0.5 Volt drop
- Total voltage drop of <0.75 V @ 55 Amps

- **Current Switching**

- Switching between high- and low-current supplies has successfully been demonstrated at 2 Amps under manual control of the power supplies
 - Software to automate process is under development
- Power supplies contribute no noise currents when switched out of circuit

- **Magnet Interface Box meets all requirements**