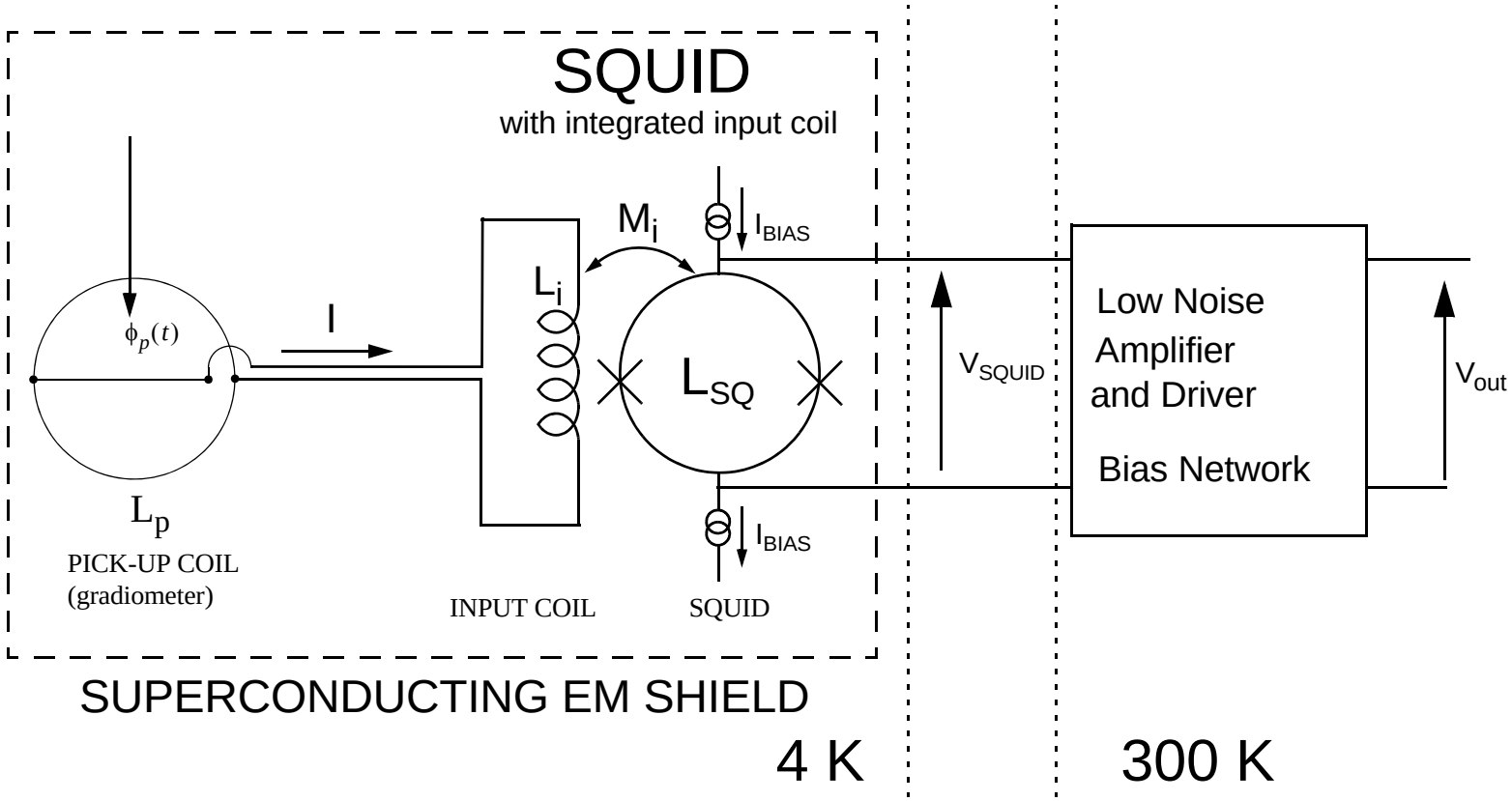
R20 Experimental and Safety Review

Gradiometers, Magnetometers, SQUIDs and Readout

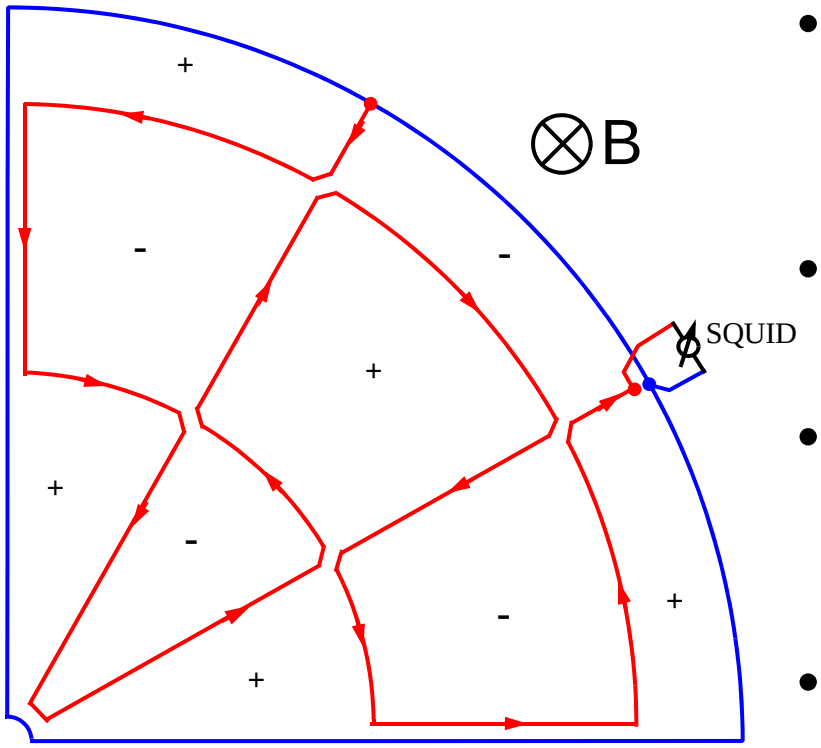
Sergio Rescia

- Block Diagram
- BNL Gradiometers, SQUIDs and Readout
- Stony Brook SQUID and Readout

SQUID and Readout



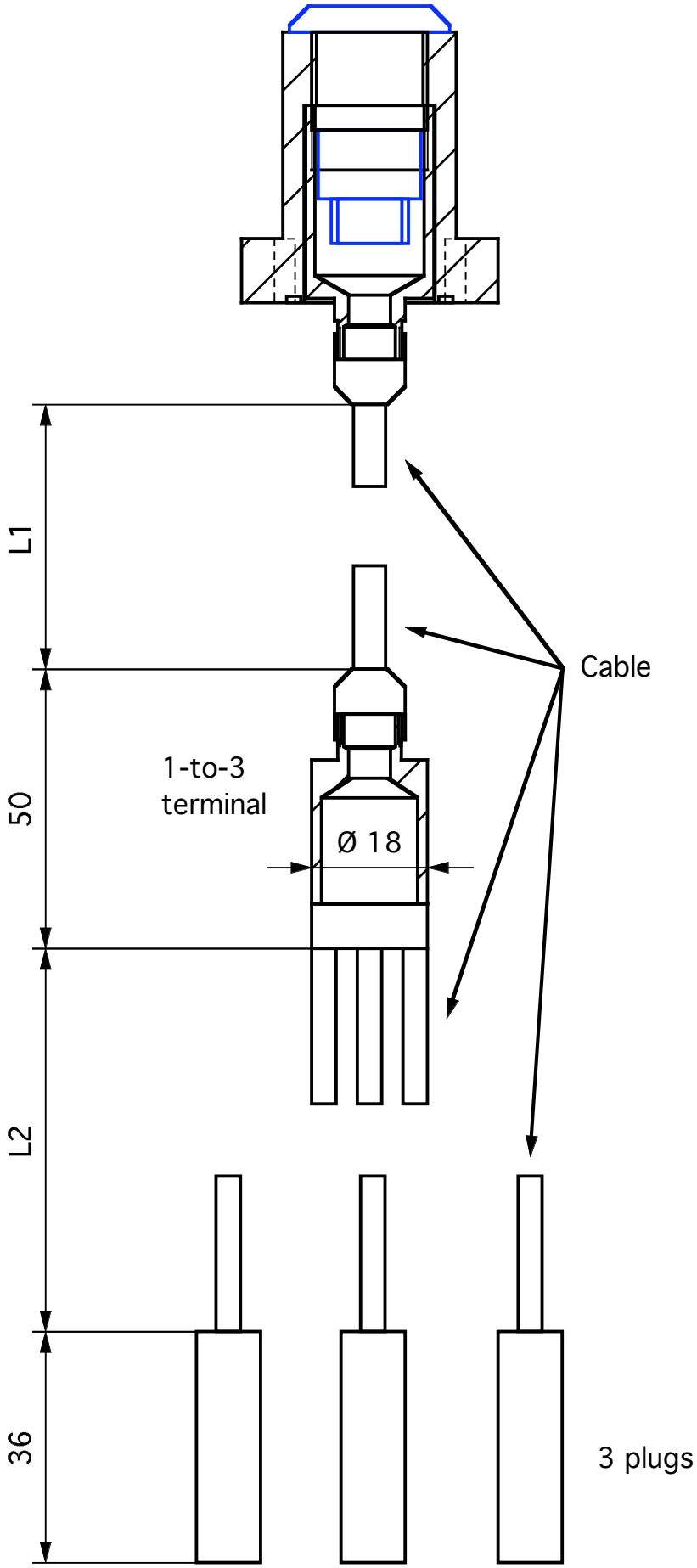
GRADIOMETER



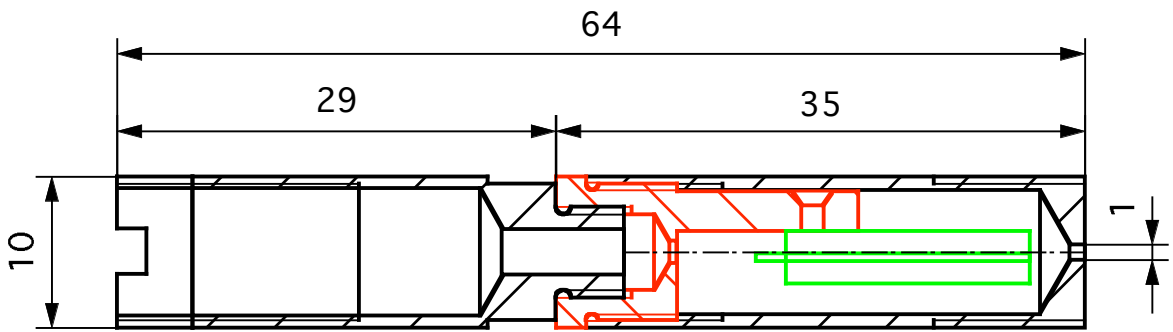
2nd order gradiometer (for clarity)

(not to scale)

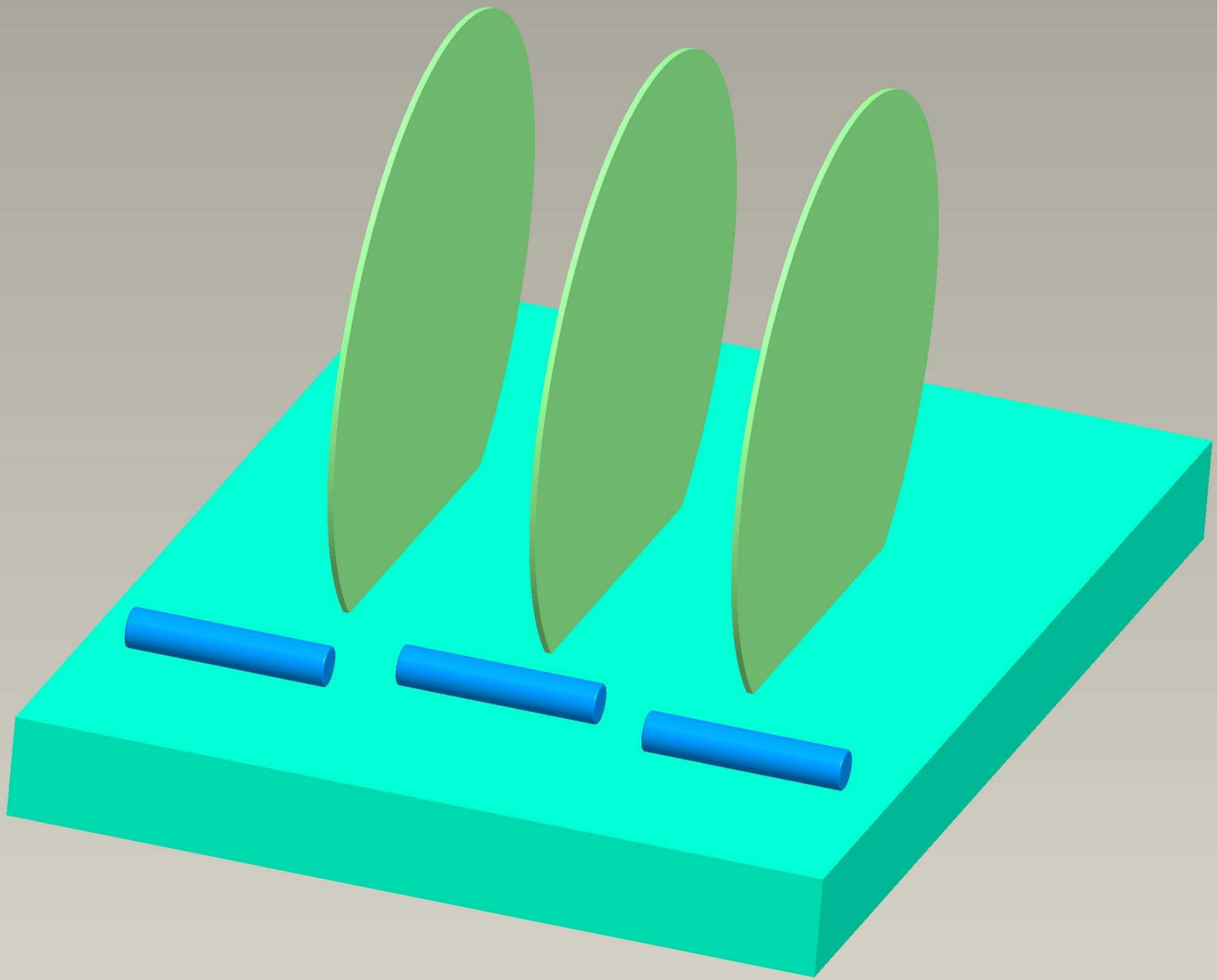
- Rejects “stray” B fields but has full sensitivity to monopole signals
- Built with superconductor on Si substrate (for cooling)
- Built in quadrants to reduce inductance and fit into 30cm commercial Si weafers
- It uses a parallel loop configuration to reduce inductance
- 3rd or 4th order gradiometer being investigated



Magnicon GbR, CC-1 with 1-to-3 terminal, Sketch, 11/2006



Magnicon GbR, Nb Capsule NC-1, Sketch, 11/2006



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SEL-1 SQUID electronics

The SQUID electronics set includes the following items:

FLL unit
- Low noise direct coupled preamlifier
- Microcontroller for digital system control
- Flux-Locked Loop mode / Amp mode
- AC and DC bias
- Automatic bias voltage tunig (AVB)
- Auxiliary on-board low noise current source
- Dynamic field compensation (DFC)
- Overload monitoring / automatic FLL reset (AR)
- Heater supply
- Upgradable to three FLL channels per set

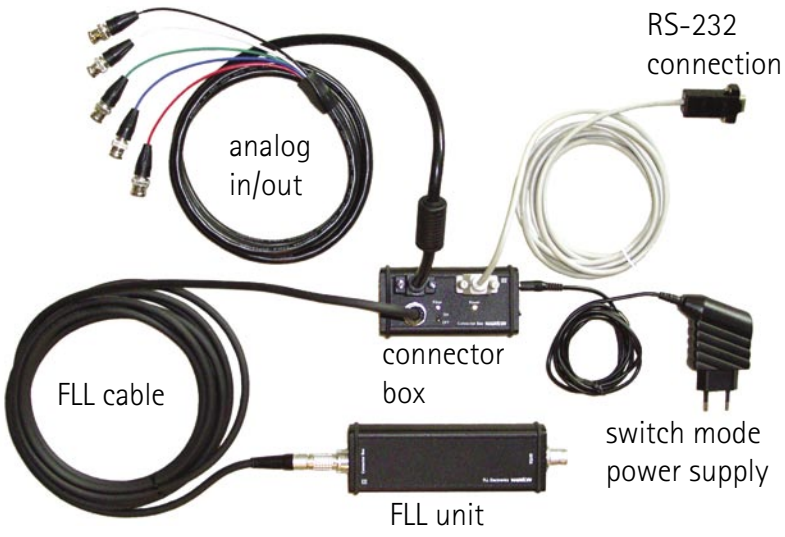
Connector Box
- Power supply
- Analog output connections
- Auxiliary analog input/output
- Anti-aliasing filter
- RS485 connection with capability to control up to 254 channels with one COM port

Cables
- 5 meters of screened cable between FLL unit and Connector box (other length available)
- PC connection cable with optically isolated RS232/RS485 converter
- Analog input/output cable
- Optional Breakout Box BOB-1

Software
- LabView® Application „SQUID-Viewer" for Windows®
- Future updates are free for our customers

Equipment
- SQUID-dummy to explore and test the system
- Small switching power supply (90-240 Volt)
- Powerline adapter if necessary

Manual
- Description of hard and software
- Description of working point adjustment and SQUID characterization



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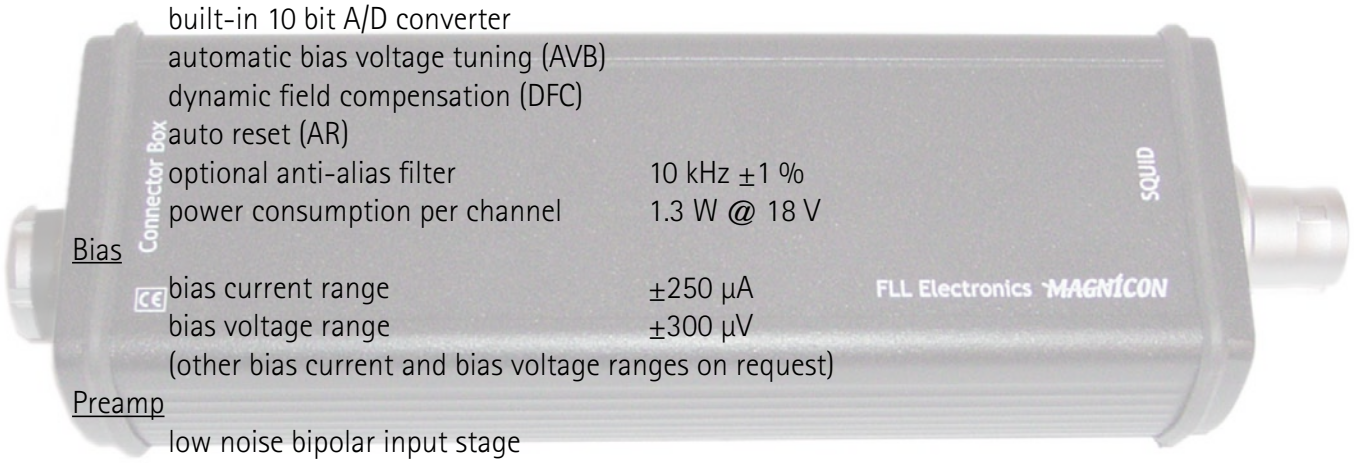
SEL-1

Technical Data



General

multi-purpose electronics for high-Tc and low-Tc SQUIDs	
1 to 3 channels per electronics unit, up to 254 channels per system	
controlled via RS-232/RS-485 interface	
LabView software included	
built-in 10 bit A/D converter	
automatic bias voltage tuning (AVB)	
dynamic field compensation (DFC)	
auto reset (AR)	
optional anti-alias filter	10 kHz ±1 %
power consumption per channel	1.3 W @ 18 V

Bias

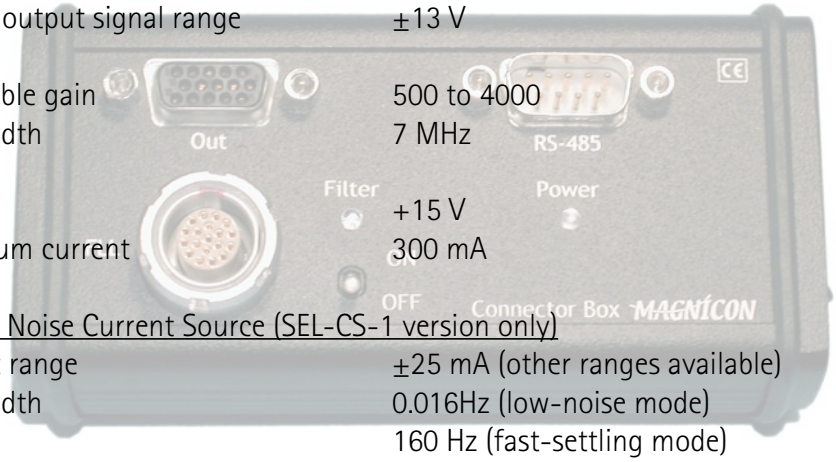
bias current range	±250 µA
bias voltage range	±300 µV
(other bias current and bias voltage ranges on request)	

Preamp

low noise bipolar input stage	
white voltage noise	0.4 nV/√Hz
voltage noise @ 0.1 Hz	0.6 nV/√Hz
white current noise	4 pA/√Hz
current noise @ 0.1 Hz	50 pA/√Hz

FLL Mode

maximum FLL bandwidth	6 MHz
fast external integrator reset	<1 µs
ac bias frequency	<250 kHz
analog output signal range	±13 V



AMP Mode

adjustable gain	500 to 4000
bandwidth	7 MHz

Heater

voltage	+15 V
maximum current	300 mA

Integrated Low Noise Current Source (SEL-CS-1 version only)

current range	±25 mA (other ranges available)
bandwidth	0.016Hz (low-noise mode)
	160 Hz (fast-settling mode)
slew rate	4.6 A/s
min. rise time	2.2 ms
resolution	12 bit
noise	7 pA/√Hz @ 1 kHz
	17 pA/√Hz @ 1Hz
	800 pA/√Hz @ 0.1 Hz
noise with coil (±70 µT range)	20 fT/√Hz @ 1 kHz

Overall height

The minimum overall height of CC-1 cryocable, attached SEL-1/XXF-1 FLL electronics and FLL cable depends on the chosen mounting option. Figure CC5 shows the minimum height of the electronics with attached FLL cable. For on-top mounting, the minimum overall height is about 321mm, for integrated mounting the overall height is about 279mm.

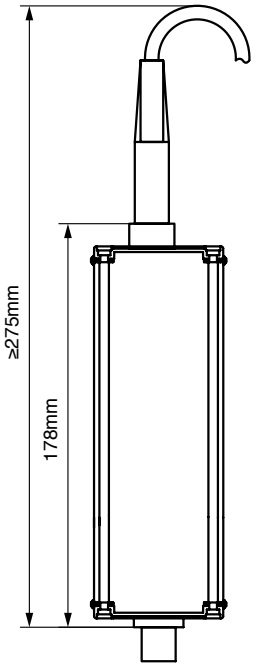
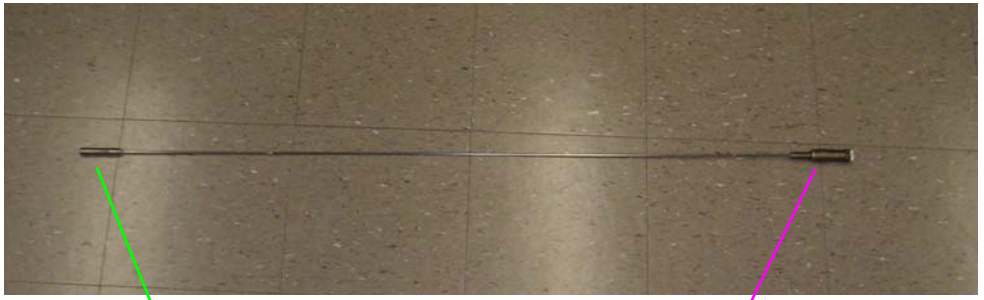


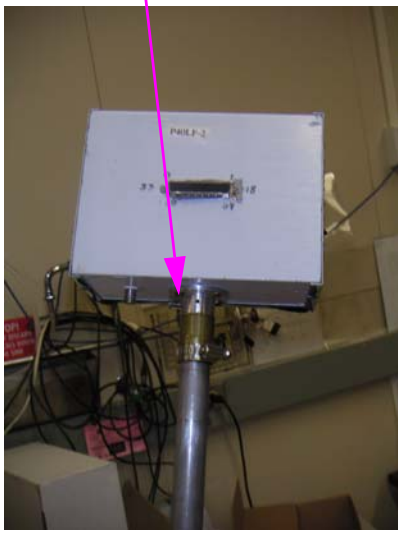
Fig. CC5: Minimum height of FLL electronics case with attached FLL cable.

Stony Book Dewar

Central Flange

“Rod” SQUID insert





Electronics: Power

- BNL will use Magnicon readout Electronics, not UL or CE listed
  Power: 70mA/ch (210mA tot) @ 18 V (~6W)
  Heather: 300mA/ch @15V (4.5W)
- Stony Brook will use in-house designed and built electronics
  Power: 200mA @ +/- 12V (4.8W)
- Both BNL and Stony Brook will use UL-listed, fused, current limited power supplies to power electronics

Data Acquisition (in Counting Room)

- “Real Time” data acquisition: Tektronix 68040 scope for BNL
- “Real Time” data acquisition: Tektronix 7104 scope for Stony Brook
- Waveform Recording: 12 bit, 250kB/sec/ch (4 channels) digitizer being developed by Andrey Sukhanov for PHENIX upgrade