LHC Class 1 DCCT precision amplifier noise

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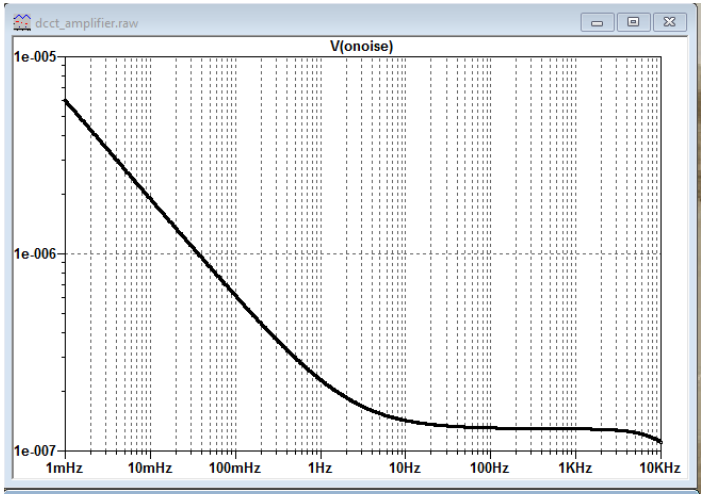
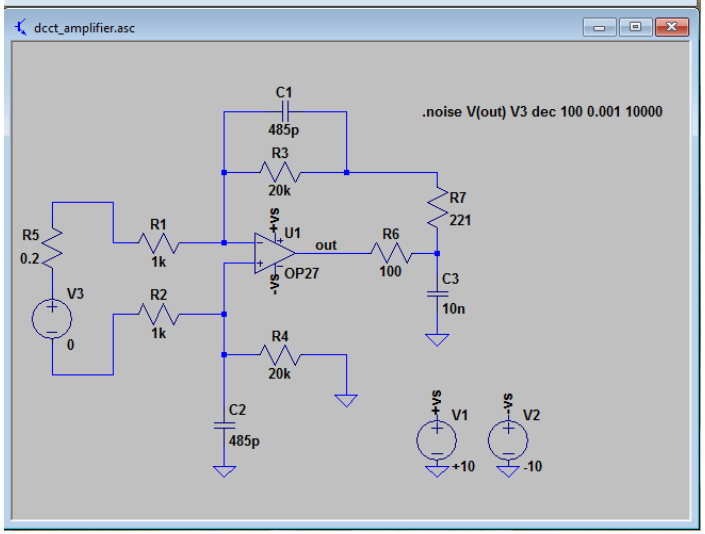
Simulations



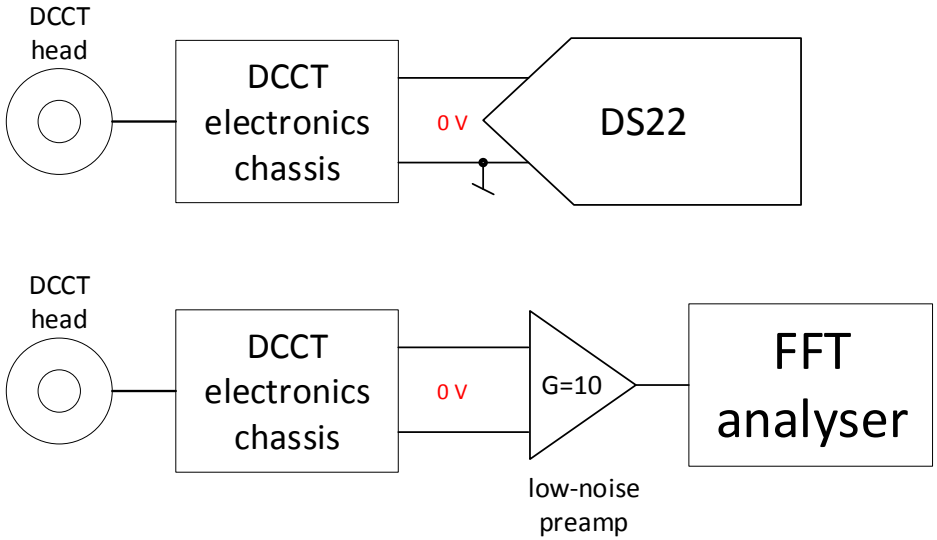


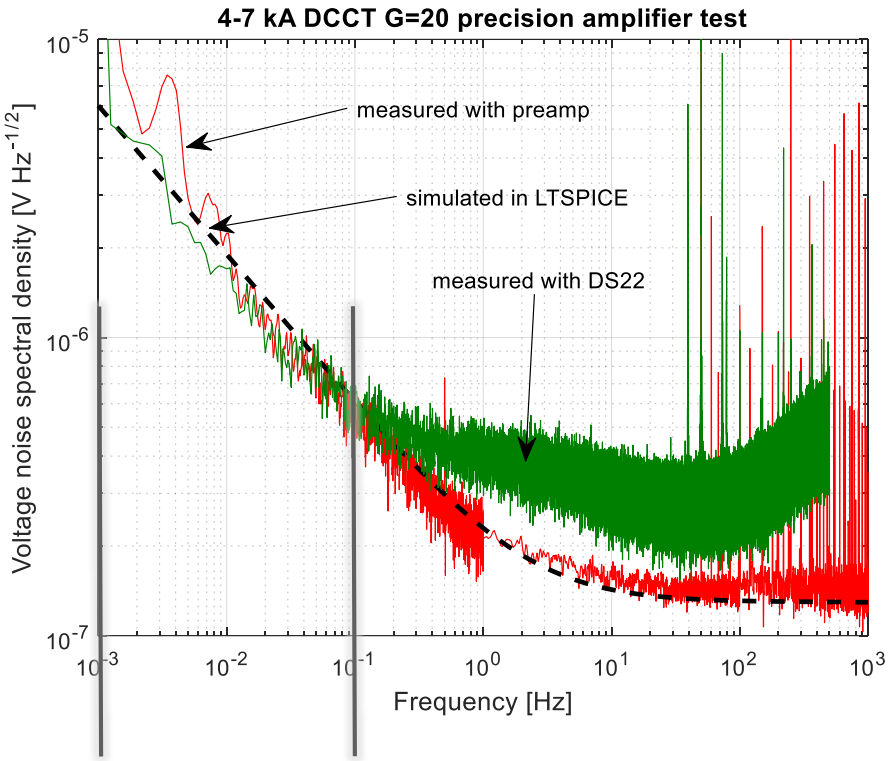
OP27 is **very well modelled** in LTSPICE, including 1/f voltage noise

For the overall amplifier, noise origins are very clear:

- 1/f noise is entirely due to OP27
- White noise has contributions both from OP27 e_n, and from the 1 kΩ resistors R1, R2
- i_n is negligible
- For the G=10 amplifier it's practically the same (RTI noise is the same, RTO is 2x higher)

Measurements at 0V



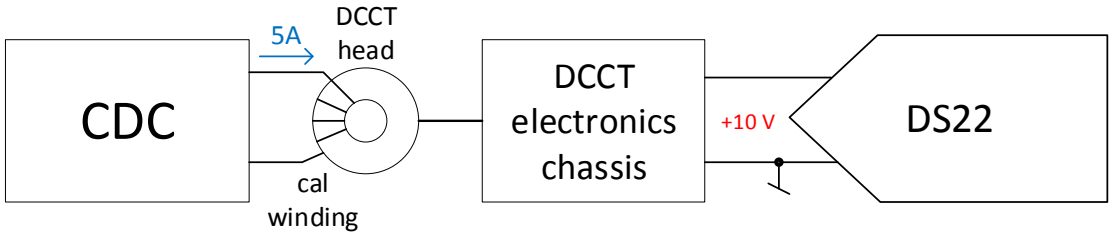


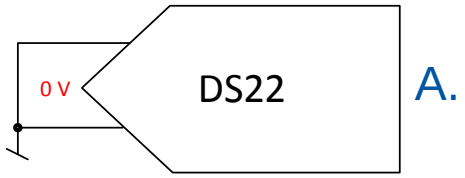
Excellent agreement of simulation and measurement results!

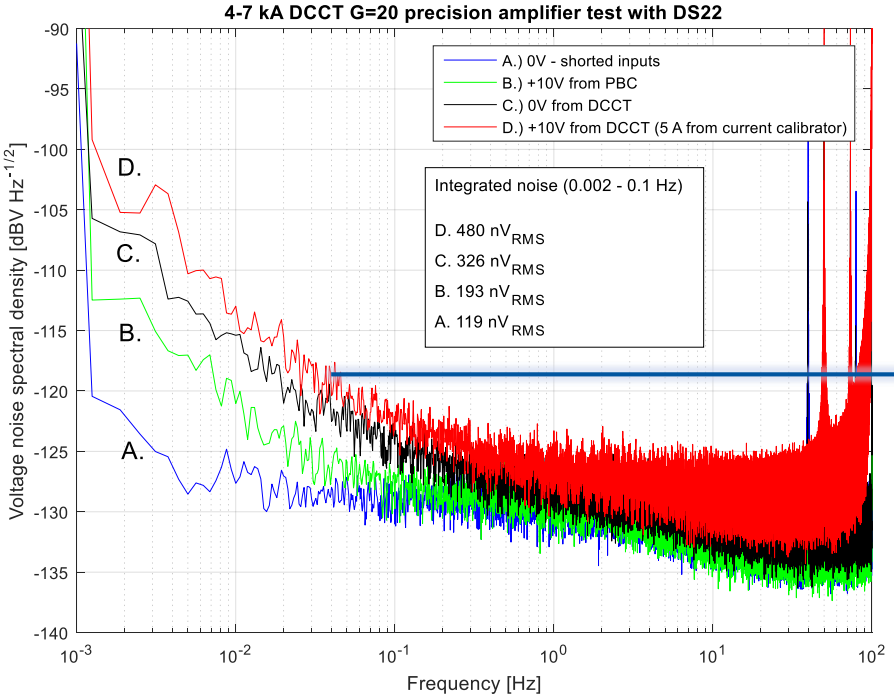
≈330 nV_{RMS} from 0.001 to 0.1 Hz

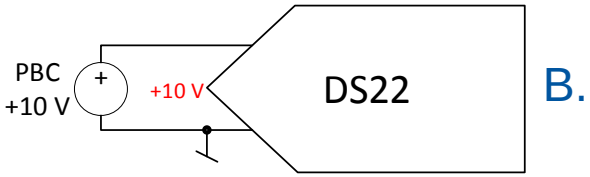
Compatible with HL-LHC Class 0

Measurements at FS









Some extra noise from the CDC *(confirmed by a separate measurement, not shown here)*

Even in this worst-case scenario, we are still within the HL-LHC Class 0 specs

Conclusions

- Class 1 DCCT electronics for LHC is compatible with the new Class 0 for HL-LHC, in terms of LF and broadband noise
- It's easy to achieve improved LF noise using a modern zero-drift amplifier
- The latter would also ensure lower temperature drift, which is particularly important for the ***fill stability*** specification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