1. Forewords

This short note presents the results of a modelling of wide range temperature measurement using a CERNOX CX1030.

The result of this study is applicable for all the temperature channels listed in the DRCU Specification Document with the exception of the channels with of range extended bellow 1K.

2. Introduction

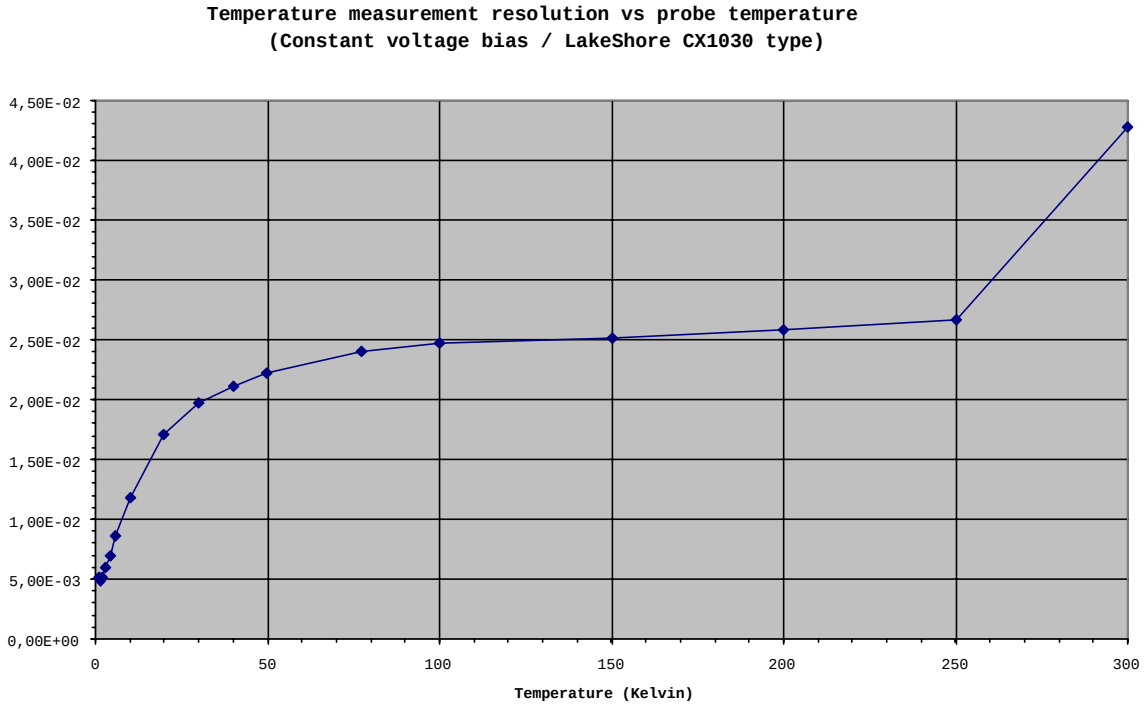
The probe is biased by a constant voltage of 10 mV as indicated by LakeShore in its “Temperature Measurement and Control” data book.

The concept uses four wires: two of are used to bias the probe and to measure the current while the two others are used to sense the actual voltage across the probe and then allow operating with high wire resistivity.

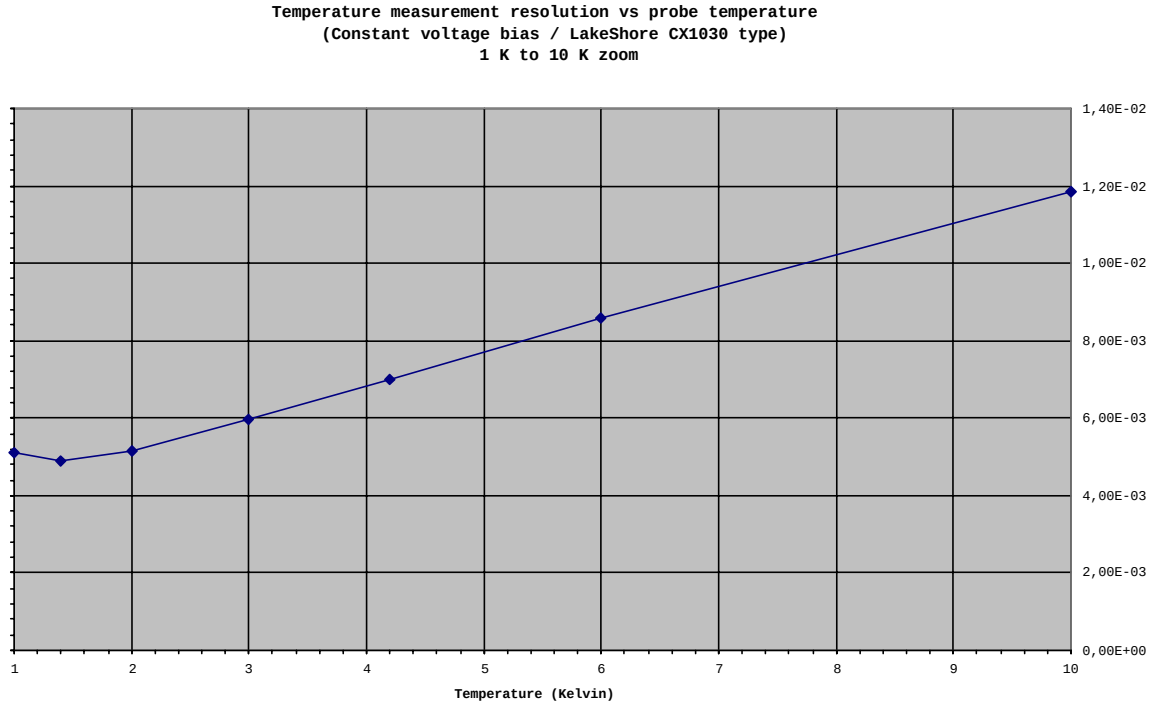
3. Temperature measurement resolution

This modelling computes the resolution achieved over considered range starting as a working assumption from a resolution at 1K of 10 mK.

The following figure shows the limited resolution degradation even for very wide temperature range and probably the possibility to have a coarse temperature indication up to ambient temperature. Even if this feature does not correspond to a formal requirement it will enables electrical continuity checking before and during cooling down of the FPU.
A resolution of about 25 mK is achieve up to 250 K.



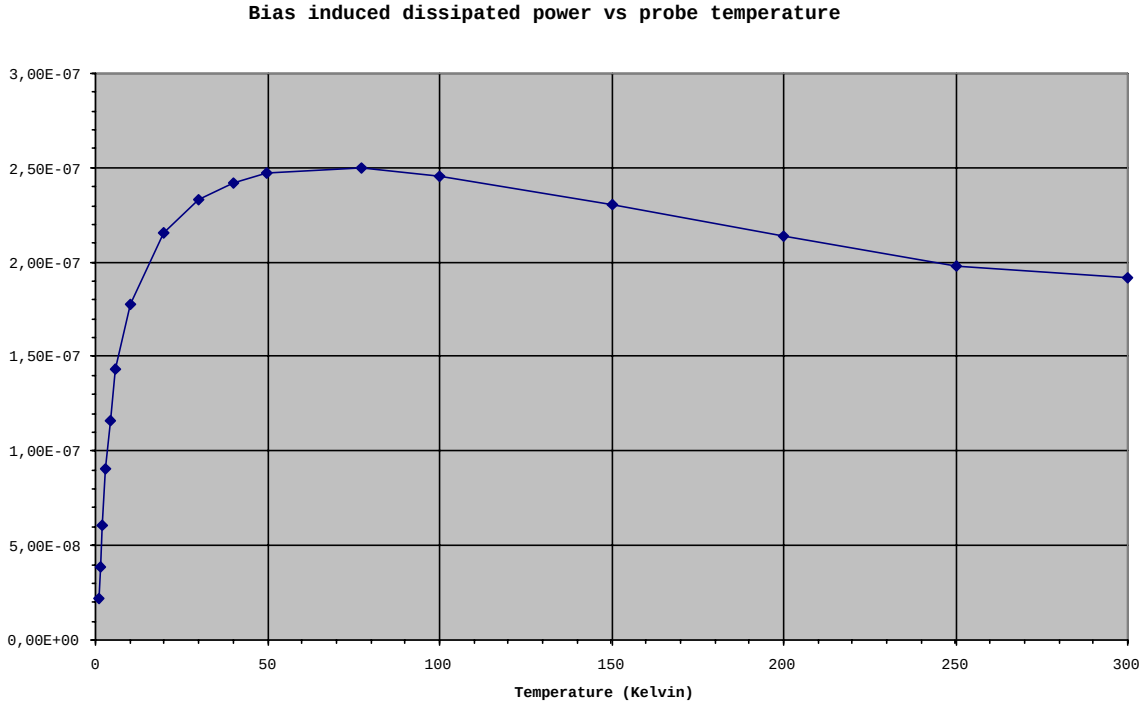
The next figure shows also the measurement resolution versus the probe temperature but for a zoomed temperature range of 1 K to 100 K.



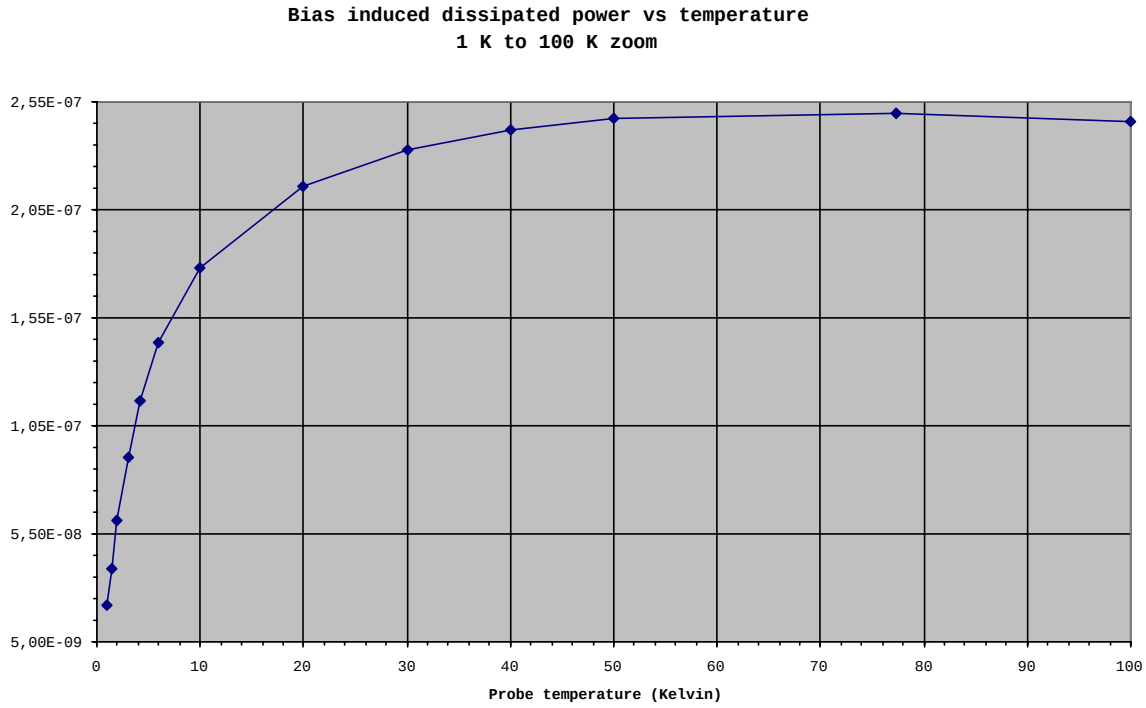
4. Power dissipated by the probe

This section summarises the result of a modelling of the power dissipated by the probe due to the constant voltage bias. This power has to be considered for the overall temperature measurement function because of the high probe to structure thermal resistance (especially at lower temperatures) as given by Lakeshore (page A-53 of the "Temperature Measurement and Control" data book).

The following figure shows the variation of this power for very wide temperature range (up to ambient temperature). The peak power is 25 µW at 80 Kelvin. The power is maximal when the probe resistance matches the resistance of a protector resistor placed in serie.



The second figure shows the same dissipated power but for a zoomed temperature range of 1K to 100 K



5. Conclusion

This study shows that the CX1030 probe is suitable for temperature measurement over a very wide range of temperature when biased by a constant voltage.

The limitations of this concept concern the resolution which is not constant all over the range (it is probably not a strong limitation for the present application) and the variation of the power dissipation with the temperature (the effect can be optimised by reducing the bias or inserting a protection resistor with the suitable table according to the effective temperature range).