	Centre National d'Etudes Spatiales	
SAP_RAD_01 TRO-33-NT-2804-CNES	**Activity : CAL/VAL** **SAPHIR** **Radiometric Sensitivity**	**Prepared by : C. Malassingne (EADS-Astrium for CNES)** **A. Rosak** **Verified by : N. Karouche**

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1. OBJECTIVE

The purpose of the document is to check that the radiometric sensitivity of all the SAPHIR instrument channels is well within the specified requirements. The sensitivity of a microwave radiometer characterizes the smallest change in input brightness temperature that can be detected in the system output for its specified integration time.

2. METHODS

2.1. OVERVIEW

In orbit radiometric sensitivity is computed from On Board Calibration Target (OBCT) samples. The physical temperature of this hot reference target is close to 290K.

For each scan of the nominal rotating mode, the SAPHIR instrument acquires 182 earth samples, 7 OBCT samples and 7 Cold Sky for calibration purpose.

The 7 OBCT samples per scan are used to calculate the radiometric sensitivity of each of the 6 channels @183GHz.

A more complete analysis of this radiometric sensitivity can be performed by configuring the instrument in fixed mode, viewing the OBCT. In this case, 196 samples can be used each scan to compute the standard deviation of the 6 channel video outputs.

2.2. CALCULATION

For each nominal mode, for each channel:

Extract the 7 OBCT samples for each of the 3733 scans.

Calculate the means and the standard deviation, for each channel.

3. SUCCESS CRITERIA

SAPHIR requirements for radiometric sensitivity are listed below:

R 7.1.2_010 For each channel, the minimum required values for NEΔT are specified in Table below for an antenna brightness temperature of 300 K.

Channels	*NEΔT Sensitivity requirement*	
	τPixel = 6.406ms	*τSample = 4.576ms*
S1	*2 K*	*2.4 K*
S2	*1.5 K*	*1.8 K*
S3	*1.5 K*	*1.8 K*
S4	*1.3 K*	*1.5 K*
S5	*1.3 K*	*1.5 K*
S6	*1.0 K*	*1.2 K*

4. PRODUCTS USED

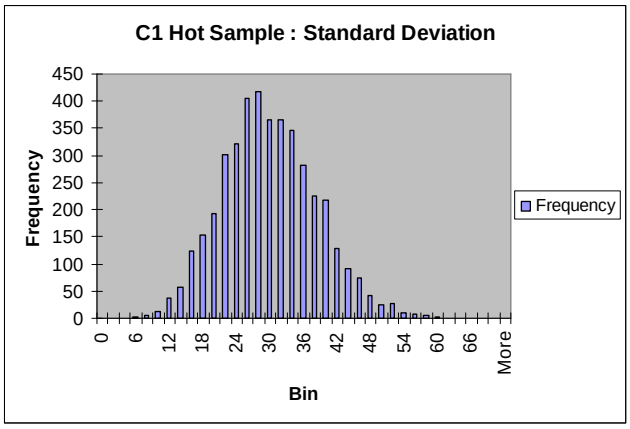
See in the graph after (X-axis).

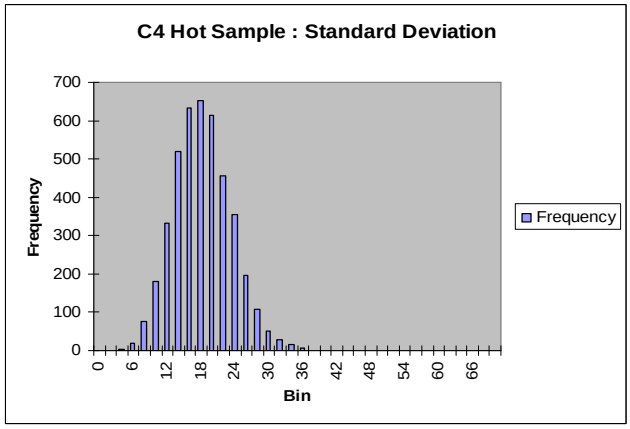
L0 products are used for this analysis.

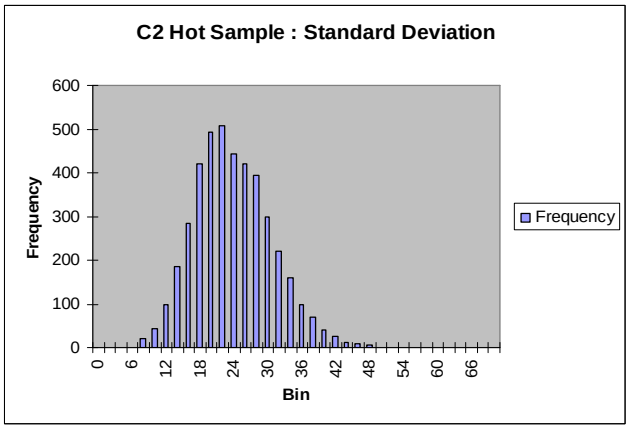
5. RESULTS

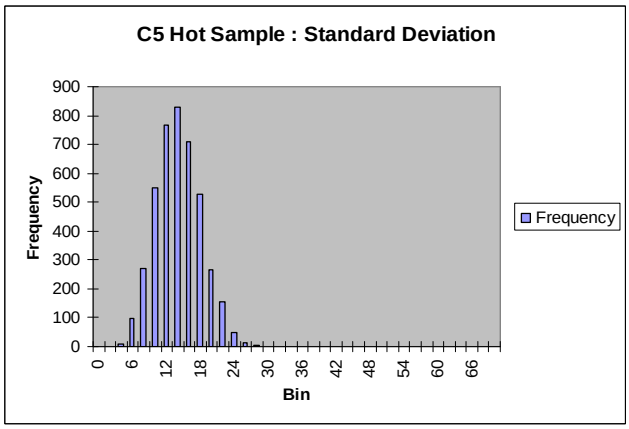
5.1. STANDARD DEVIATION OF THE OBCT SAMPLE

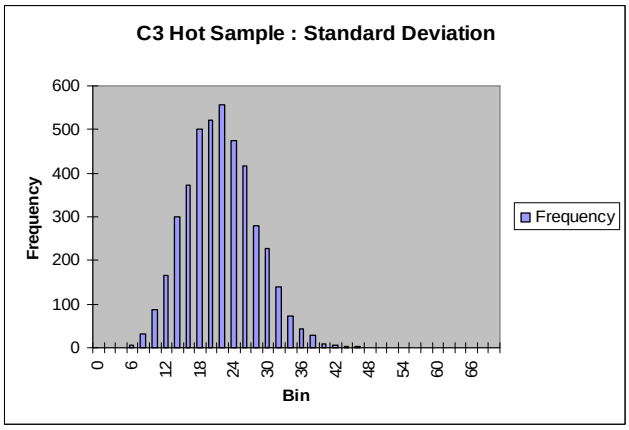
Here after, we have plotted the distribution of the standard deviation measured on the seven hot calibration samples for each scan for the six channels during one orbit (3733 scans). This standard deviation is in count)

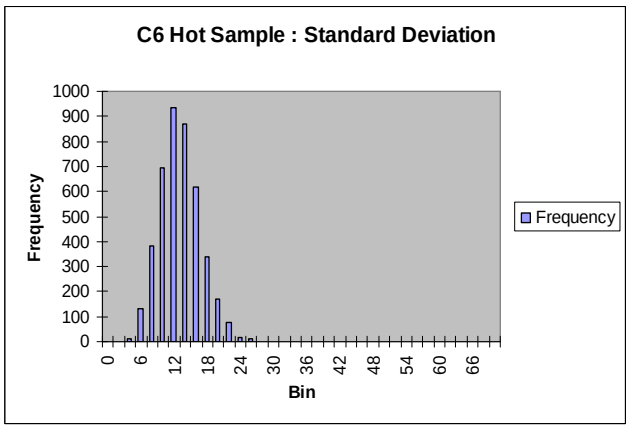










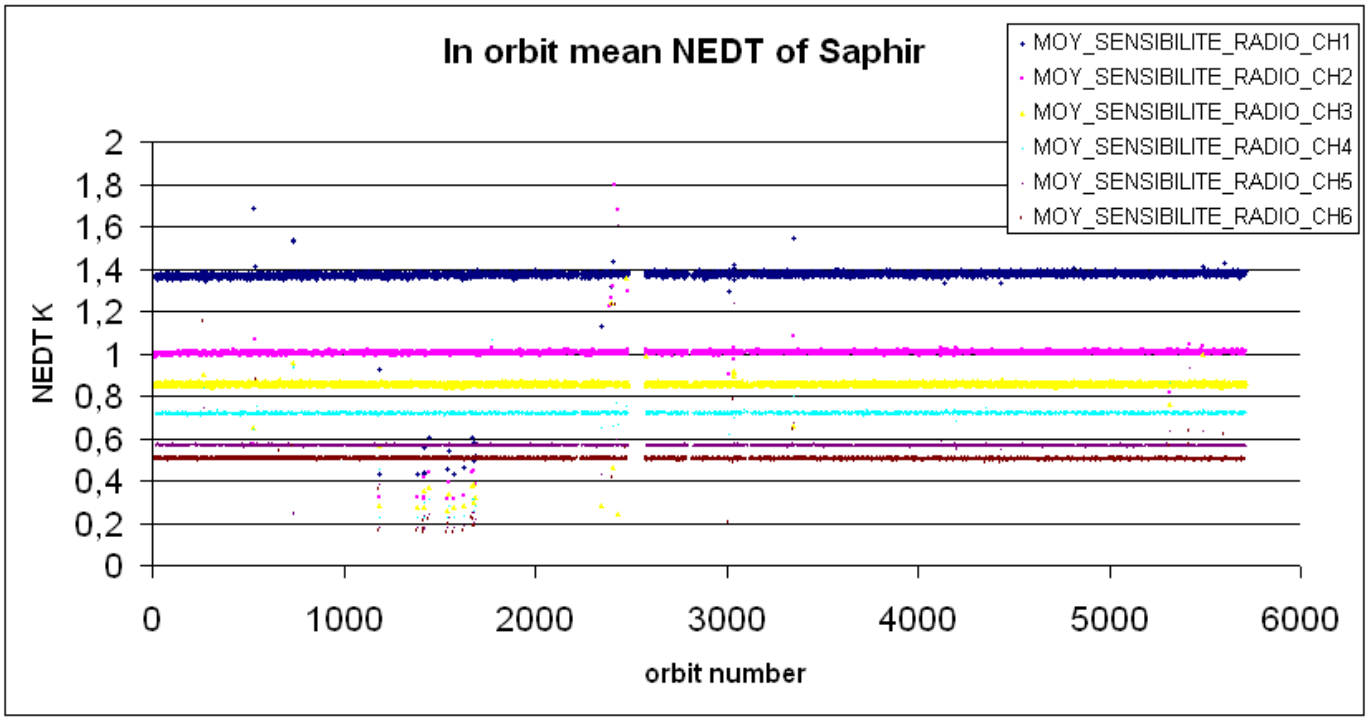


5.2. RADIOMETRIC SENSITIVITY

As shown in the table below, sensitivity performances are slightly better than on-ground measurements. Both on-ground and in-orbit measurements show that the NEΔT are much better than specified.

NEΔT (K)	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5	Channel 6
Requirement	2.4	1.8	1.8	1.5	1.5	1.2
On-ground	1.52	1.09	0.95	0.82	0.66	0.56
In-orbit	1.36	1.00	0.86	0.72	0.57	0.50

Here below are illustrated the radiometric sensitivity (NEΔT) variations of the 6 channels. They are the average value for each orbit (each orbit corresponds to a set of 3733 scans).



NEΔT are very stable over a long term period (more than one year on the graph above).

NEΔT is computed for each orbit number. It is the mean of NEΔT computed by scan for this orbit. Abnormal points on this graph are due to some corrupted orbits, or some missing data inside an orbit. It has been checked that each abnormal point is not physical.

6. CONCLUSION

Radiometric sensitivities are much better than required. The in-orbit values are slightly better than the last on-ground values, measured during thermal vacuum.

These performances are very stable from the instrument switch ON.