	Centre National d'Etudes Spatiales	
SCA _RAD_02 TRO-34-NT-2781-CNES	**Activity : CAL/VAL** **Scarab** **Thermal leak correction**	**Prepared by :** **A Rosak** **Verified by :** **N Karouche**

Contents

1. OBJECTIVE

Here are the typical Scarab channel signatures. Cut-off wavelength for Channel 2 (in black) is around 5µm. At this wavelength, a small amount of thermal radiation is still present. So the solar filter associated to C2 does not perfectly block infrared emissions of the Earth surface.

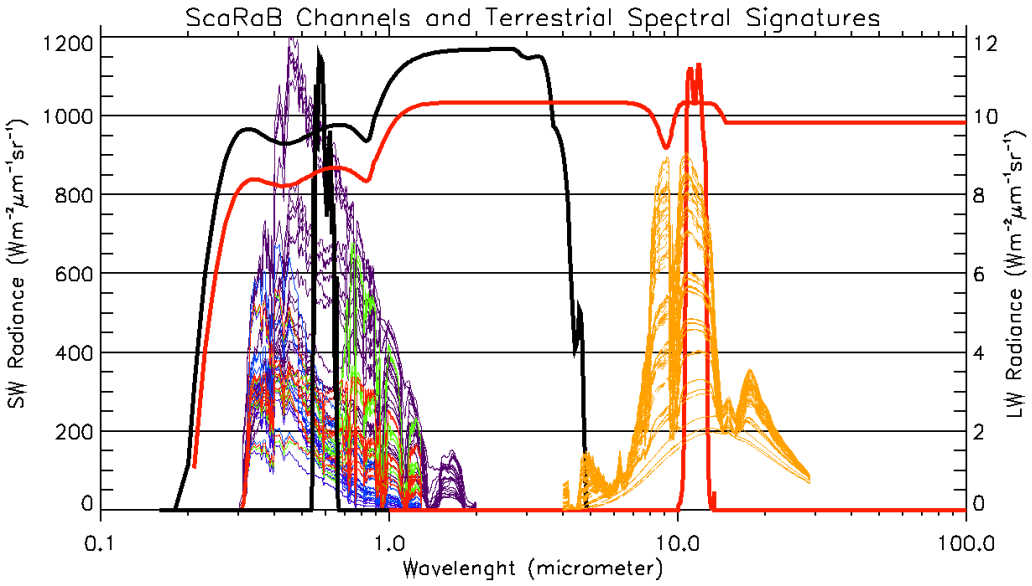


Figure 1. ScaRaB channels signatures.

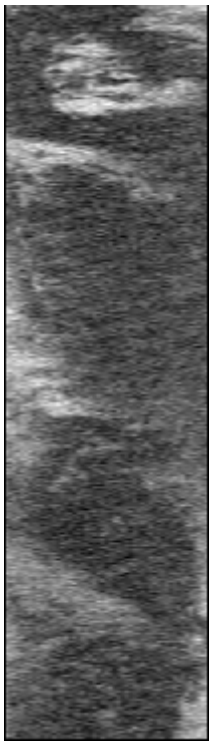
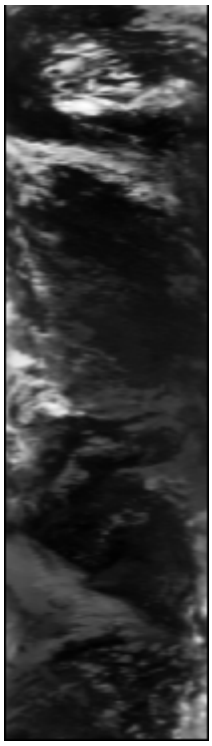
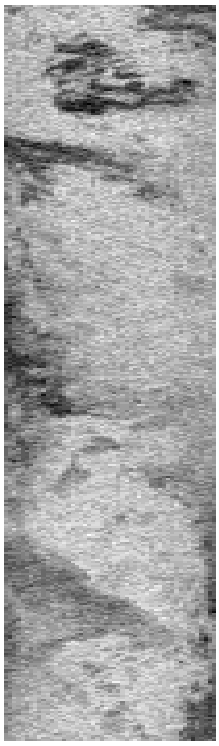
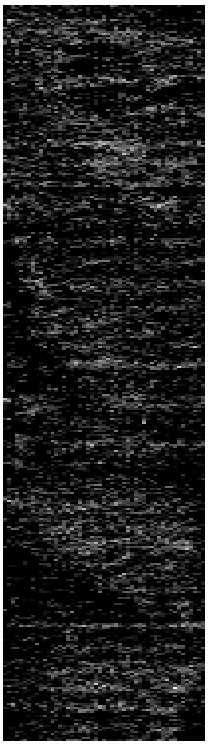
So channel 2 (solar channel) has a small thermal leak, that must be corrected at level 1 product.

In order to subtract this IR component to the Channel 2 signal, it is possible to apply a method called “thermal clean up”. Thermal leak can be estimated with IR window channel 4. A 2nd degree polynomial make the link between channel 4 radiance (L_{4_IRW}) and channel 2 thermal leak. The coefficients of this polynomial are computed by using night scenes. Once the coefficients of the polynomial have been determined, Channel 2 radiance (L_{2_SW}) can be clean up according to:

$$L_{2\_SW} = \frac{N_2}{G_{2\_sw}} - \left\{a_2.(L_{4\_IRW})^2 + a_1.L_{4\_IRW} + a_0\right\}$$

The objective of this document is to check that thermal leak is well corrected.

Here is an example of LVL 0, channel 2, night area, not corrected, channel 4, and LVL 1, channel 2 (corrected).

Channel 2 Level 0	Channel 4 Level 0	Channel 2 Level 1 (not corrected)	Channel 2 Level 1 (corrected)
			
		STD value : 0.13 W/m²/sr	Mean value : 0.03W/m²/sr STD value : 0.06 W/m²/sr or 1.6 LSB

In the night area, the same structures can be seen between Channel 2 (before correction) and Channel 4.

After correction, it is not possible to see these structures.

2. METHODS

2.1. OVERVIEW

During night acquisition, the mean radiance of channel 2 should be equal to 0 W/m²/sr, if the thermal leak is well corrected.

The noise on these black areas should also be very similar to the noise calculated on space pixels.

2.2. CALCULATION

Calculation must be done at level 0 product, but after thermal leak correction.

1/ Select a nigh area with a minimum of 300 scans.

2/ Calculate the mean of these 300x51 values

3/ Calculate the standard deviation of these 300x51 values.

This can be done for channel 2 to check thermal leak correction.

3. SUCCESS CRITERIA

	Channel 2
Mean	<1 LSB
Standard deviation	<3 LSB

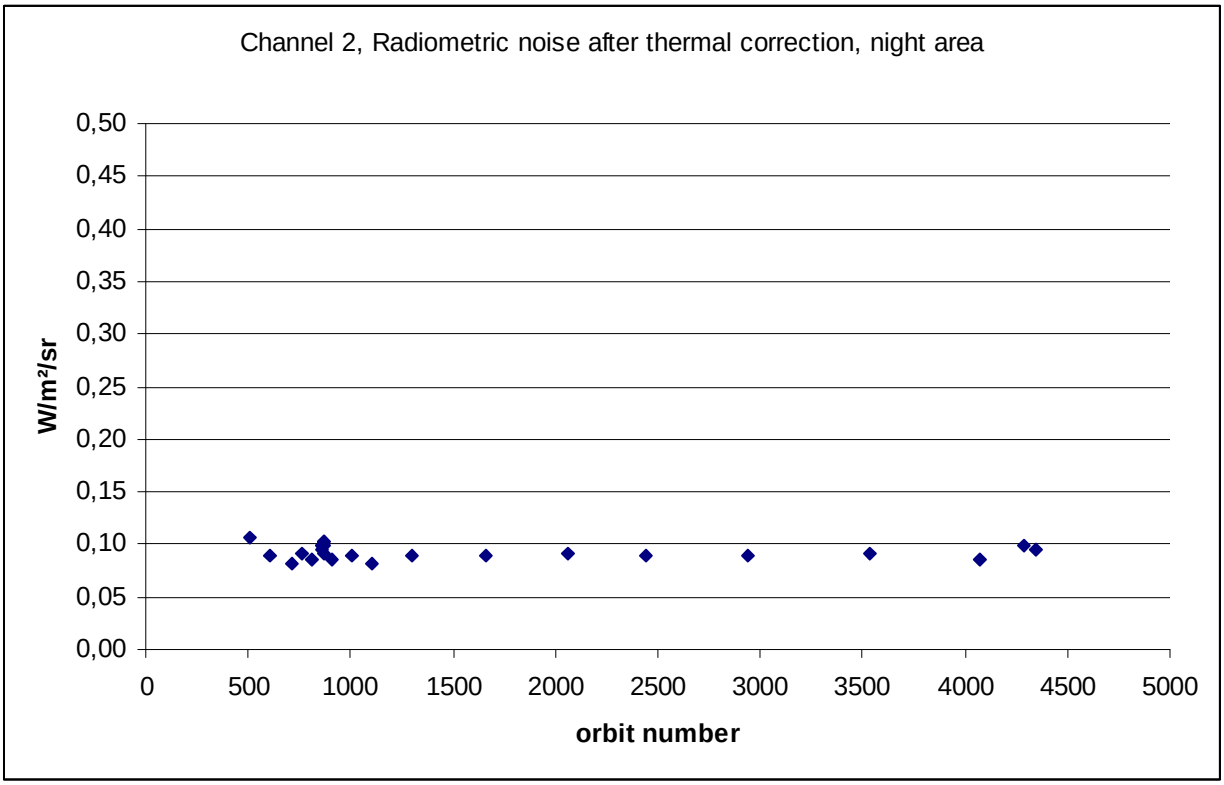
4. PRODUCTS USED

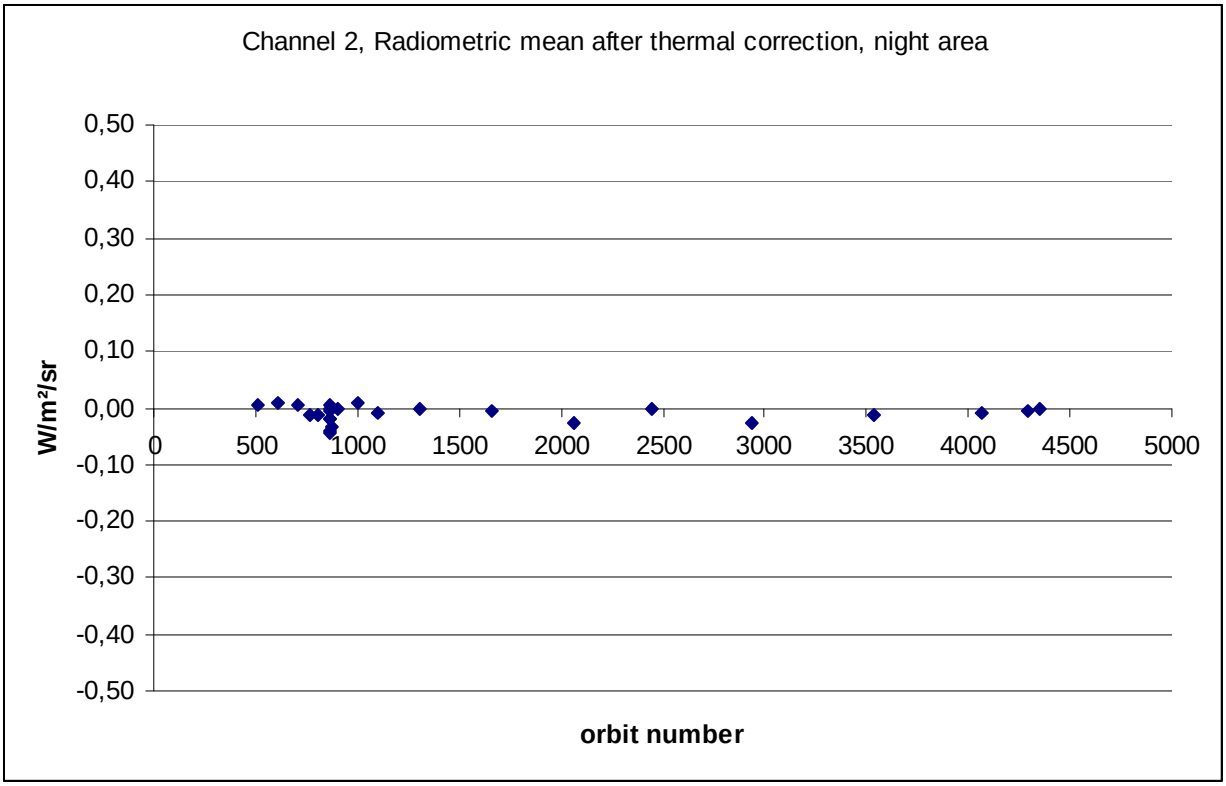
See in the table below.

5. RESULTS FOR CHANNEL 2

Orbit number	Mode	Standard deviation **with** thermal leak correction		Standard deviation **without** thermal leak correction	Mean **with** thermal leak correction		Mean **without** thermal leak correction
		LSB	W/m²/sr	LSB	LSB	W/m²/sr	LSB
511	MS	3.0	0,11	3.7	0,1	0,00	-18.9
610	MS	2.5	0,09	4.1	0,2	0,01	-17.2
710	MS	2.3	0,08	4.1	0,1	0,00	-18.5

765	Nominal	2.6	0,09	4.1	-0,3	-0,01	-18.3
860	Nominal	2.7	0,10		0,1	0,00	
861	Nominal	2.8	0,10		0	0,00	
863	Nominal	2.8	0,10		-0,5	-0,02	
866	Nominal	2.8	0,10		-0,1	0,00	
867	Nominal	2.9	0,10		-0,5	-0,02	
868	Nominal	2.9	0,10		-1,1	-0,04	
869	Nominal	2.6	0,09		-1,2	-0,04	
870	Nominal	2.8	0,10		-0,9	-0,03	
808	MS	2.4	0,09		-0,3	-0,01	
907	MS	2.4	0,09		0	0,00	
1006	MS	2.5	0,09		0,2	0,01	
1105	MS	2.3	0,08		-0,2	-0,01	
1302	MS	2.5	0,09		0	0,00	
1663	Nominal	2.5	0,09	3.5	-0,1	0,00	-19
2059	Nominal	2.6	0,09		-0,7	-0,02	
2442	Nominal	2.5	0,09		0	0,00	
2939	Nominal	2.5	0,09		-0,7	-0,02	
3532	Nominal	2.6	0,09		-0,3	-0,01	
4070	Nominal	2.4	0,09		-0,2	-0,01	
4290	Nominal	2.8	0,10	-3.5	-0,1	0,00	-18.7
4350	Nominal	2.7	0,10		0	0,00	





6. CONCLUSION

Thermal leak of channel 2 is well corrected. Mean radiometric noise is at 2.6 LSB, coherent with the radiometric noise measured on space pixel (2.5 LSB)

Thermal leak is stable (no change of the polynomial).