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Issue	Date	Sheet	Description of Change	Release
1.0		All	First Issue of the Document	===

TABLE OF CONTENTS

1 INTRODUCTION AND SCOPE

This document reports on the RCA28 Flight Model on – ground calibration. Tests were performed from 12 May 2006 to 24 May 2006 (including functional tests) at Alcatel Alenia Space – Milano according to the LFI Calibration Plan.

Three additional tests have been performed:

- ST3 with other P/S
- LIS with small ref temperature variations
- Check of spikes with all the environmental acquisition off.

The following tests have been performed:

Date	Filename	Notes
12-mag-06	044LFI25_RCA_FM_AMB_200605121101	Functional tests at room temperature
12-mag-06	044LFI25_RCA_FM_AMB_200605121121	Functional tests at room temperature, all channels on
12-mag-06	044LFI25_RCA_FM_AMB_200605121218	Swept source test at ambient temperature on main arm
12-mag-06	044LFI25_RCA_FM_AMB_200605121250	Swept source test at ambient temperature on side arm
15-mag-06	044LFI25_RCA_FM_CRY_200605150838	Functional tests at cryogenic temperature
15-mag-06	044LFI25_RCA_FM_CRY_200605151004	Functional tests at cryogenic temperature, all channels on
18-mag-06	044LFI25_RCA_FM_CRY_200605180847	Functional tests at cryogenic temperature. Corrupted file
18-mag-06	044LFI25_RCA_FM_CRY_200605180922	Functional tests at cryogenic temperature, all channels on. Corrupted file
18-mag-06	044LFI25_RCA_FM_CRY_200605180947	Check on RACHEl functionality
18-mag-06	044LFI25_RCA_FM_CRY_200605180959	Functional tests at cryogenic temperature
18-mag-06	044LFI25_RCA_FM_CRY_200605181012	Functional tests at cryogenic temperature, all channels on
18-mag-06	030LFI25_RCA_FM_XXX_200605181026	PS/SW I-V curves
18-mag-06	044LFI25_RCA_FM_TUN_200605181146	PS/SW tuning
18-mag-06	044LFI25_RCA_FM_TUN_200605181404	VG1 tuning: 1st T step
18-mag-06	044LFI25_RCA_FM_TUN_200605181512	VG1 tuning: 2nd T step
18-mag-06	044LFI25_RCA_FM_TUN_200605181620	VG2 tuning
18-mag-06	044LFI25_RCA_FM_TUN_200605181857	DAE tuning
18-mag-06	044LFI25_RCA_FM_ST3_200605181920	ST3 test starts
19-mag-06	044LFI25_RCA_FM_ST3_200605190355	"
19-mag-06	044LFI25_RCA_FM_OFT_200605191158	File errouneously opened
19-mag-06	044LFI25_RCA_FM_UNC_200605191202	Unchopped test with In1 rev., In 2 for., on all channles
19-mag-06	044LFI25_RCA_FM_UNC_200605191246	Unchopped test; M1/S1: In1 dir., In2 rev.; M2/S2: In1 rev., In2 dir.
19-mag-06	044LFI25_RCA_FM_UNC_200605191342	Unchopped test with In1 dir., In 2 rev., on all channles
19-mag-06	044LFI25_RCA_FM_UNC_200605191441	Unchopped test; M2/S2: In1 dir., In2 rev.; M1/S1: In1 rev., In2 dir.
19-mag-06	044LFI25_RCA_FM_SPR_200605191600	RCA swept source test (-32 dBm input power level)
19-mag-06	044LFI25_RCA_FM_THF_200605191641	RCA susceptibility test to thermal changes of the FEM
19-mag-06	044LFI25_RCA_FM_THV_200605191757	RCA susceptibility test to thermal changes of the V-groove
19-mag-06	044LFI25_RCA_FM_ST3_200605191847	ST3 test with 4kHz switching on M2/S2
20-mag-06	044LFI25_RCA_FM_ST3_200605190327	"
20-mag-06	044LFI25_RCA_FM_ELE_200605201120	RCA ELE test on VG1
20-mag-06	044LFI25_RCA_FM_ELE_200605201229	RCA ELE test on VG2
20-mag-06	044LFI25_RCA_FM_ELE_200605201430	RCA ELE test on V drain
20-mag-06	044LFI25_RCA_FM_LIS_200605201539	RCA linearity and TN test with temeprature steps both on sky and reference load
21-mag-06	044LFI25_RCA_FM_LIS_200605210004	"
21-mag-06	044LFI25_RCA_FM_LIS_200605210847	"
21-mag-06	044LFI25_RCA_FM_LIS_200605211720	"
22-mag-06	044LFI25_RCA_FM_LIS_200605220154	"
22-mag-06	044LFI25_RCA_FM_OFT_200605221623	RCA offset test

22-mag-06	044LFI25_RCA_FM_AMB_200605221713	PS/SW I-V curves 2nd check (label is wrong. It is not a test at ambient temeprature. It is a cryogenic test)
22-mag-06	044LFI25_RCA_FM_THB_200605221744	RCA susceptibility test to thermal changes of the BEM
23-mag-06	044LFI25_RCA_FM_LIS_200605231059	RCA LIS test (small T steps on ref; from 8.2K to 9.7K; 0.05K each)
23-mag-06	044LFI25_RCA_FM_LIS_200605231943	"
24-mag-06	044LFI25_RCA_FM_LIS_200605240416	"
24-mag-06	044LFI25_RCA_FM_XXX_200605240937	Check on RCA 25 spikes

2 APPLICABLE DOCUMENTS

[AD 1] M.Bersanelli, *Planck-LFI Calibration Plan*, PL-LFI-PST-PL-008, Issue/Rev 1.0, July 2003

3 REFERENCE DOCUMENTS

[RD 1] P. Battaglia, RCA#25 at 44 GHz Test Report, PL-LFI-LAB-RP-065

4 ANNEXES

[ANNEX 1] P. Battaglia, F. Villa, RCA_SPR_1600 RaNA Report.
[ANNEX 2] RCA_LIS RaNA Report

5 TUNING

See [RD 1].

6 BASIC PERFORMANCES

6.1 RCA_LING: LINEARITY, ISOLATION, NOISE AND GAIN

This test includes both the RCA_LIS and the RCA_TNG. Files are named LIS. The linearity has been evaluated extensively by changing both the REF and the SKY temperature in several steps. From this data the noise temperature, isolation and gain can be also evaluated.

We found a problems on the SKY load temperature control reflected also to an instability of the Reference load as well. The SKY LOAD eccosorb is dumped such fluctuation due to its very high thermal inertia. The REF LOAD eccosorb is not. All the data stream with SKY temperature variations have the REF radiometric signal strongly affected by these fluctuations. These temperature fluctuations do not prevent the derivation of main calibration parameters. However all the receiver properties derived from differential data (for instance White noise) are affected.

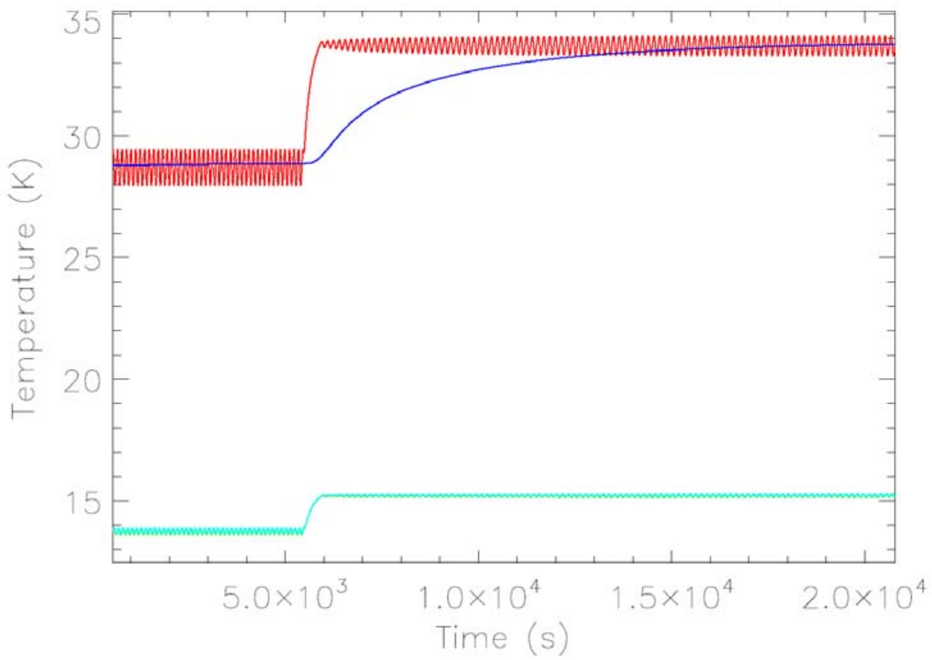


Figure 6-1: *Example of sensor data steam. Red: SKY controller. Blue: SKY Eccosorb. Green: REF sensor (here the RMON_TMP and the REF_TEMP are very close one to each other).*

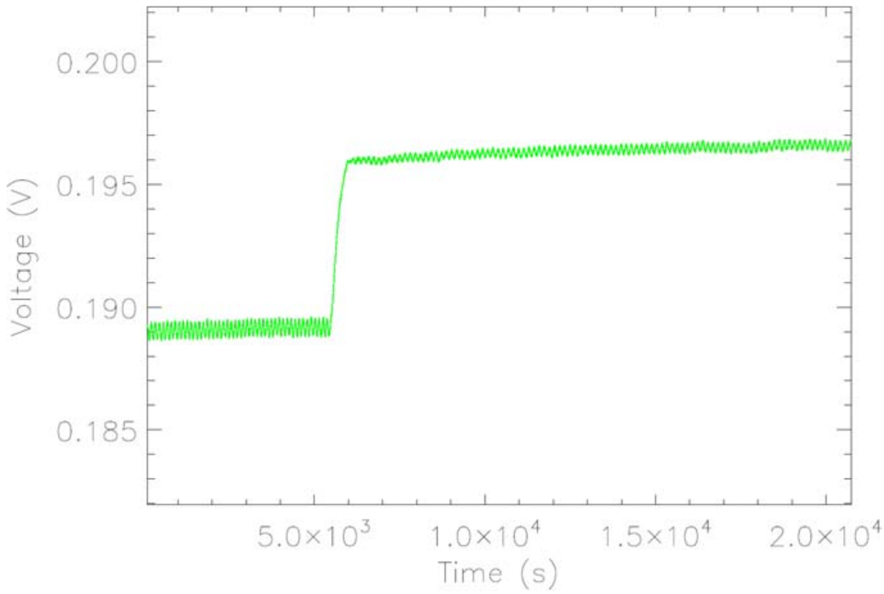


Figure 6-2: *Radiometric REF output signal from Detector A..*

From these datasets the characteristic curves V output Vs. T input were built for each detector and then linear and parabolic fits have been performed, as reported in next sections. In addition a gain model has been developed and results are reported as a "*gain-model*" fit.

6.1.1 Reference temperature steps

Noise temperature calculated using RaNa procedures (P. Battaglia). Note that these values have been obtained considering the BEM offset.

```
================================================================================
INPUT
Centre frequency (Hz) =,    4.4000000e+10
Channel: A
Changing signal: Load
BEM offset (v) =,    0.00340000

There are ,          10 , time windows
   ,tmin, tmax
 ,     225.00 ,     722.00
 ,    2257.00 ,    4154.00
 ,    5825.00 ,    7767.00
 ,    9619.00 ,   11425.00
 ,   13006.00 ,   15038.00
 ,   16890.00 ,   18606.00
 ,   20232.00 ,   22264.00
 ,   24025.00 ,   25922.00
 ,   27231.00 ,   29399.00
 ,   30356.00 ,   30830.00

 ,Tchange, Tfixed, Vchange, Vfixed
 ,     8.122349739075 ,    10.845998764038 ,     0.154884146561 ,     0.161740962978
 ,     9.714027404785 ,    10.845999717712 ,     0.162923169082 ,     0.162072932074
 ,    11.909742355347 ,    10.897792816162 ,     0.173814948378 ,     0.162744542208
 ,    14.101269721985 ,    11.117090225220 ,     0.184406795893 ,     0.164155837443
 ,    16.293554306030 ,    11.400143623352 ,     0.194650521614 ,     0.165943178359
```

```
 ,    18.493659973145 ,    11.737550735474 ,     0.204643616249 ,     0.168079528708
 ,    20.687551498413 ,    12.069025039673 ,     0.214377260108 ,     0.170218396580
 ,    22.884937286377 ,    12.416210174561 ,     0.223809914411 ,     0.172413990354
 ,    25.079776763916 ,    12.737361907959 ,     0.233027443288 ,     0.174461490055
 ,    27.267183303833 ,    12.952797889709 ,     0.241890692609 ,     0.175888192324

OUTPUT
           ******** Linear fit **********

Parameters
 ,Gain (V/K),Tn (K),Iso. (dB),Lin. coeff
 ,     0.004313772004 ,    26.908557889072 ,   -13.236203875763 ,     0.001489910527

Statistical uncertainties
 ,Gain (V/K),Tn (K),Iso. (dB),Lin. coeff
 ,     0.000026206202 ,     0.161491632508 ,     3.533411467357 ,     0.000570687263

           ******** Parabolic fit **********

Average noise temperature
 ,Tn (k),Sigma (K)
 ,    15.150474186853 ,     0.645589263186

Temperature versus Voltage parabolic fit parameters
Equation: T = a0 + a1 * V + a2 * V^2
 ,a0,a1,a2
 ,   -15.150197159520 ,    95.442693908005 ,   312.271203827073

 ,sigma(a0),sigma(a1),sigma(a2)
 ,     0.005350101076 ,     0.055471632278 ,     0.141288664569

Voltage versus temperature parabolic fit parameters
Equation: V = a0 + a1 * T + a2 * T^2
 ,a0,a1,a2
 ,     0.117025361511 ,     0.005534242142 ,    -0.000029499754

 ,sigma(a0),sigma(a1),sigma(a2)
 ,     0.001344646105 ,     0.000201573094 ,     0.000006298951
============================================================

INPUT
Centre frequency (Hz) =,    4.4000000e+10
Channel: B
Changing signal: Load
BEM offset (v) =,    0.00470000

There are ,          10 , time windows
   ,tmin, tmax
 ,     225.00 ,     722.00
 ,    2257.00 ,    4154.00
 ,    5825.00 ,    7767.00
 ,    9619.00 ,   11425.00
 ,   13006.00 ,   15038.00
 ,   16890.00 ,   18606.00
 ,   20232.00 ,   22264.00
 ,   24025.00 ,   25922.00
 ,   27231.00 ,   29399.00
 ,   30356.00 ,   30830.00

 ,Tchange, Tfixed, Vchange, Vfixed
 ,     8.122349739075 ,    10.845998764038 ,     0.174980127247 ,     0.182252423553
 ,     9.714027404785 ,    10.845999717712 ,     0.184035381751 ,     0.182542442037
 ,    11.909742355347 ,    10.897792816162 ,     0.196346265102 ,     0.183218757694
 ,    14.101269721985 ,    11.117090225220 ,     0.208290251307 ,     0.184675123016
 ,    16.293554306030 ,    11.400143623352 ,     0.219875876520 ,     0.186617761420
 ,    18.493659973145 ,    11.737550735474 ,     0.231218334368 ,     0.188961012516
 ,    20.687551498413 ,    12.069025039673 ,     0.242297701143 ,     0.191331811089
 ,    22.884937286377 ,    12.416210174561 ,     0.253106385756 ,     0.193812252138
 ,    25.079776763916 ,    12.737361907959 ,     0.263593047674 ,     0.196029087665
 ,    27.267183303833 ,    12.952797889709 ,     0.273728881030 ,     0.197557177076

OUTPUT
           ******** Linear fit **********

Parameters
 ,Gain (V/K),Tn (K),Iso. (dB),Lin. coeff
 ,     0.004929094161 ,    26.833014960091 ,   -14.024586712642 ,     0.001513712058

Statistical uncertainties
 ,Gain (V/K),Tn (K),Iso. (dB),Lin. coeff
 ,     0.000035026783 ,     0.199005012157 ,     5.109773618432 ,     0.000740826107

           ******** Parabolic fit **********

Average noise temperature
 ,Tn (k),Sigma (K)
 ,    15.952842196430 ,     0.591718559483

Temperature versus Voltage parabolic fit parameters
Equation: T = a0 + a1 * V + a2 * V^2
 ,a0,a1,a2
 ,   -15.952348657914 ,    92.604608849054 ,   224.363568732155
```

```
 ,sigma(a0),sigma(a1),sigma(a2)
 ,     0.007027546779 ,     0.064398624990 ,     0.144986532781

Voltage versus temperature parabolic fit parameters
Equation: V = a0 + a1 * T + a2 * T^2
 ,a0,a1,a2
 ,     0.132443017849 ,     0.006203509075 ,    -0.000031125269

 ,sigma(a0),sigma(a1),sigma(a2)
 ,     0.001344646105 ,     0.000201573094 ,     0.000006298951
===========================================================

INPUT
Centre frequency (Hz) =,    4.4000000e+10
Channel: C
Changing signal: Load
BEM offset (v) =,    0.00490000

There are ,          10 , time windows
   ,tmin, tmax
 ,     225.00 ,     722.00
 ,    2257.00 ,    4154.00
 ,    5825.00 ,    7767.00
 ,    9619.00 ,   11425.00
 ,   13006.00 ,   15038.00
 ,   16890.00 ,   18606.00
 ,   20232.00 ,   22264.00
 ,   24025.00 ,   25922.00
 ,   27231.00 ,   29399.00
 ,   30356.00 ,   30830.00

 ,Tchange, Tfixed, Vchange, Vfixed
 ,     8.122349739075 ,    10.845998764038 ,     0.169215529965 ,     0.176117279311
 ,     9.714027404785 ,    10.845999717712 ,     0.177716239315 ,     0.176522681121
 ,    11.909742355347 ,    10.897792816162 ,     0.189072524318 ,     0.177273501296
 ,    14.101269721985 ,    11.117090225220 ,     0.200000447284 ,     0.178771480918
 ,    16.293554306030 ,    11.400143623352 ,     0.210488243854 ,     0.180692114210
 ,    18.493659973145 ,    11.737550735474 ,     0.220622114015 ,     0.182964644101
 ,    20.687551498413 ,    12.069025039673 ,     0.230324885492 ,     0.185175651877
 ,    22.884937286377 ,    12.416210174561 ,     0.239809385999 ,     0.187584857445
 ,    25.079776763916 ,    12.737361907959 ,     0.248824472531 ,     0.189693711733
 ,    27.267183303833 ,    12.952797889709 ,     0.257545498034 ,     0.191249921229

OUTPUT
           ******** Linear fit **********

Parameters
 ,Gain (V/K),Tn (K),Iso. (dB),Lin. coeff
 ,     0.004330599602 ,    29.695070310063 ,   -12.643269086093 ,     0.001884727514

Statistical uncertainties
 ,Gain (V/K),Tn (K),Iso. (dB),Lin. coeff
 ,     0.000029339915 ,     0.190584638219 ,     3.305608246989 ,     0.000621944181

           ******** Parabolic fit **********

Average noise temperature
 ,Tn (k),Sigma (K)
 ,    11.887861103675 ,     0.581406456160

Temperature versus Voltage parabolic fit parameters
Equation: T = a0 + a1 * V + a2 * V^2
 ,a0,a1,a2
 ,   -11.886893073646 ,    44.289318678999 ,   402.296855600917

 ,sigma(a0),sigma(a1),sigma(a2)
 ,     0.006652210301 ,     0.063748416240 ,     0.150401512455

Voltage versus temperature parabolic fit parameters
Equation: V = a0 + a1 * T + a2 * T^2
 ,a0,a1,a2
 ,     0.129059494160 ,     0.005932352361 ,    -0.000039471732

 ,sigma(a0),sigma(a1),sigma(a2)
 ,     0.001344646105 ,     0.000201573094 ,     0.000006298951
===========================================================

INPUT
Centre frequency (Hz) =,    4.4000000e+10
Channel: D
Changing signal: Load
BEM offset (v) =,    0.00550000

There are ,          10 , time windows
   ,tmin, tmax
 ,     225.00 ,     722.00
 ,    2257.00 ,    4154.00
 ,    5825.00 ,    7767.00
 ,    9619.00 ,   11425.00
 ,   13006.00 ,   15038.00
 ,   16890.00 ,   18606.00
 ,   20232.00 ,   22264.00
 ,   24025.00 ,   25922.00
```

```
 ,   27231.00 ,   29399.00
 ,   30356.00 ,   30830.00

 ,Tchange, Tfixed, Vchange, Vfixed
 ,     8.122349739075 ,    10.845998764038 ,     0.168890756089 ,     0.176776925193
 ,     9.714027404785 ,    10.845999717712 ,     0.177376584036 ,     0.177178258089
 ,    11.909742355347 ,    10.897792816162 ,     0.188760984597 ,     0.177933703071
 ,    14.101269721985 ,    11.117090225220 ,     0.199806436088 ,     0.179512055456
 ,    16.293554306030 ,    11.400143623352 ,     0.210339742945 ,     0.181441418506
 ,    18.493659973145 ,    11.737550735474 ,     0.220565876618 ,     0.183769372955
 ,    20.687551498413 ,    12.069025039673 ,     0.230423735617 ,     0.186072685818
 ,    22.884937286377 ,    12.416210174561 ,     0.239959073428 ,     0.188481479356
 ,    25.079776763916 ,    12.737361907959 ,     0.249131952056 ,     0.190651316527
 ,    27.267183303833 ,    12.952797889709 ,     0.257878248317 ,     0.192171961611

OUTPUT
           ******** Linear fit **********

Parameters
 ,Gain (V/K),Tn (K),Iso. (dB),Lin. coeff
 ,     0.004355068894 ,    29.319830016380 ,   -12.525462613627 ,     0.001846512965

Statistical uncertainties
 ,Gain (V/K),Tn (K),Iso. (dB),Lin. coeff
 ,     0.000029316975 ,     0.185185684249 ,     3.225523799436 ,     0.000643824238

           ******** Parabolic fit **********

Average noise temperature
 ,Tn (k),Sigma (K)
 ,    12.375902310700 ,     0.580077325884

Temperature versus Voltage parabolic fit parameters
Equation: T = a0 + a1 * V + a2 * V^2
 ,a0,a1,a2
 ,   -12.375021672688 ,    50.845414629460 ,   382.796819723130

 ,sigma(a0),sigma(a1),sigma(a2)
 ,     0.006581637097 ,     0.063139610212 ,     0.149082443811

Voltage versus temperature parabolic fit parameters
Equation: V = a0 + a1 * T + a2 * T^2
 ,a0,a1,a2
 ,     0.128577937422 ,     0.005946357955 ,    -0.000038766469

 ,sigma(a0),sigma(a1),sigma(a2)
 ,     0.001344646105 ,     0.000201573094 ,     0.000006298951
===========================================================
```

The input data used for the analysis are reported in Table 6-1

Table 6-1: Input data used to derive the calibration curve of the RCA using temperature steps on REF. All the temperature are Antenna Temperature (Kelvin). Voltages are in Volts.

Detectors A and B			Detector C and D		
T REF	Detector A Voltage	Detector B Voltage	T REF	Detector C Voltage	Detector D Voltage
7.11228	0.15828	0.17968	7.11228	0.17411	0.17439
8.69656	0.16635	0.18876	8.69656	0.18262	0.1829
10.88579	0.17721	0.20107	10.88579	0.19392	0.19423
13.07177	0.18779	0.21306	13.07177	0.20493	0.20532
15.26066	0.19809	0.22459	15.26066	0.21547	0.21592
17.45679	0.2081	0.23604	17.45679	0.2256	0.22615
19.64962	0.2178	0.24702	19.64962	0.23531	0.23603
21.84559	0.22721	0.25782	21.84559	0.24476	0.24552
24.03867	0.23652	0.26835	24.03867	0.25376	0.25465
26.22555	0.24542	0.27856	26.22555	0.26257	0.26353
28.42064	0.25424	0.28855	28.42064	0.27103	0.27206
30.62906	0.26257	0.29816	30.62906	0.27925	0.28054
32.81195	0.27089	0.30774	32.81195	0.28704	0.28838

The following fits have been performed (V is voltage in Volt and T is the input antenna temperature in Kelvin):

- linear fit: `V=a0+a1*T`
- parabolic fit V(T): `V=a0+a1*T+a2*T^2`
- inverse parabolic fit T(V): `T=a0+a1*V+a2*V^2`
- gain-model fit V(T) : `V = G*(T+T0)/(1+b*G*(T+T0)) (T0 is the Tn)`

The fit results are reported here:

Table 6-2: *Fitting parameters for REF steps.*

	Linear Fit V(T)		Parabolic Fit V(T)			Gain Model Fit V(T)		
	a0	a1	a0	a1	a2	G	T0	B
Detector A	0.12985	0.00438	0.12074	0.00549	-2.78999E-5	0.00758	18.17818	1.10582
Detector B	0.14717	0.00498	0.13743	0.00617	-2.98613E-5	0.00838	18.6345	0.92933
Detector C	0.14658	0.00439	0.13447	0.00586	-3.71044E-5	0.00925	17.37273	1.32946
Detector D	0.14643	0.00444	0.1346	0.00587	-3.62591E-5	0.00912	17.55817	1.28916

Based on the fit results the noise temperatures have been estimated from the reference load temperature steps and are reported in table

Table 6-3: *Noise Temperatures estimated from four different fitting function applied on data with REF steps.*

	T noise (K) Linear Fit	T noise (K) Parabolic Fit V(T)	T noise (K) Gain-Model Fit V(T)
Detector A	29.6	20.0	18.2
Detector B	29.6	20.3	18.6
Detector C	33.4	20.3	17.4
Detector D	33.4	20.4	17.6

6.1.1.1 Photometric gain with REF variations

The overall photometric gain can be calculated as follows:

- linear fit: `G0=a1 (K/V)`
- parabolic fit V(T): `G1=dV/dT (V/K)`
- gain-model fit V(T) : `G3= G/(1+b*G*(T+T0))`

In the case of non linear fit the photometric gain depends on the input temperature. The gain functions are reported hereafter:

Photometric Gain from Linear fit

Detector A: `G0 = 0.00438 (V/K)`
Detector B: `G0 = 0.00498 (V/K)`
Detector C: `G0 = 0.00439 (V/K)`
Detector D: `G0 = 0.00444 (V/K)`

Photometric Gain from Parabolic V(T) fit

Detector A: `G1 = 0.00549 -5.58E-05 * T (V/K)`
Detector B: `G1 = 0.00617 -5.98E-05 * T (V/K)`
Detector C: `G1 = 0.00586 -7.42E-05 * T (V/K)`
Detector D: `G1 = 0.00587 -7.26E-05 * T (V/K)`

Photometric Gain from Gain-Model V(T) fit

Detector A: `G3 = 0.00758/(1.15237+0.0084*T) (V/K)`
Detector B: `G3 = 0.00838/(1.14512+0.0078*T) (V/K)`
Detector C: `G3 = 0.00925/(1.21364+0.0123*T) (V/K)`
Detector D: `G3 = 0.00912/(1.20643+0.0118*T) (V/K)`

6.1.2 Sky Temperature Steps

The temperature sensor used for the analysis is the `SMON_TMP` (ID = 09) which is the thermometer located on the Eccosorb SKY LOAD pyramids. Standard deviation of T and V has not taken into account on the fit.

Using the RaNa routine `receiver_basic_properties` the temperature (antenna) and the voltages have been carried out for each single data file. Then all the values have been combined to perform the fits (in IDL) outside the RaNa environment. The data are reported in the following tables.

***Table 6-4**: Input data as derived from `receiver_basic_properties` RaNa routine used to perform the fits. Only T change and Vchange data have been used. Antenna Temperatures are in Kelvin, Voltages in Volts.*

T SKYMON	Detector A Voltage	Detector B Voltage	Detector C Voltage	Detector D Voltage
15.218	0.1928	0.21893	0.20974	0.21111
18.4048	0.2076	0.23609	0.22479	0.22632
21.55438	0.22139	0.2522	0.23883	0.24039
24.6939	0.23483	0.26798	0.2523	0.25415
27.82117	0.24788	0.28314	0.26514	0.26721
32.74831	0.26686	0.30558	0.28368	0.28613

As in the previous case (Reference steps) the following fits have been performed (V is voltage in Volt and T is the input antenna temperature in Kelvin):

- linear fit: `V=a0+a1*T`
- parabolic fit V(T): `V=a0+a1*T+a2*T^2`
- gain-model fit V(T) : `V = G*(T+T0)/(1+b*G*(T+T0)) (T0 is the Tn)`

The parameters of the linear and parabolic fits have been reported hereafter. Note that all the fits have been performed in antenna temperature and not in physical temperature.

***Table 6-5**: Fitting parameters for SKY steps.*

	Linear Fit V(T)		Parabolic Fit V(T)			Gain Model Fit V(T)		
	a0	a1	a0	a1	a2	G	T0	B
Detector A	0.12961	0.00423	0.11515	0.00551	-2.68066E-5	0.00766	16.83686	1.11278
Detector B	0.14488	0.00495	0.12928	0.00633	-2.89287E-5	0.0085	16.85441	0.90081
Detector C	0.14693	0.00422	0.12846	0.00586	-3.42448E-5	0.0092	16.129	1.29932
Detector D	0.14728	0.00428	0.12984	0.00583	-3.23301E-5	0.00887	16.8296	1.22087

Based on the fit results the noise temperatures have been estimated from the reference load temperature steps and are reported in table

***Table 6-6:** Noise Temperatures estimated from three different fitting function applied on data with SKY steps.*

	T noise (K) Linear Fit	T noise (K) Parabolic Fit V(T)	T noise (K) Gain-Model Fit V(T)
Detector A	30.6	19.1	16.8
Detector B	29.3	18.8	16.9
Detector C	34.8	19.7	16.1
Detector D	34.4	20.0	16.8

6.1.2.1 Photometric Gain with SKY variations

The overall photometric gain can be calculated as follows:

- linear fit: `G0=a1 (K/V)`
- parabolic fit V(T): `G1=dV/dT (V/K)`
- gain-model fit V(T) : `G3= G/(1+b*G*(T+T0))`

In the case of non linear fit the photometric gain depends on the input temperature. The gain functions are reported hereafter:

Photometric Gain from Linear fit

Detector A: `G0 = 0.00423 (V/K)`
Detector B: `G0 = 0.00495 (V/K)`
Detector C: `G0 = 0.00422 (V/K)`
Detector D: `G0 = 0.00428 (V/K)`

Photometric Gain from Parabolic V(T) fit

Detector A: `G1 = 0.00551 – 5.36E-05 * T (V/K)`
Detector B: `G1 = 0.00633 – 5.78E-05 * T (V/K)`
Detector C: `G1 = 0.00586 – 6.84E-05 * T (V/K)`
Detector D: `G1 = 0.00583 – 6.46E-05 * T (V/K)`

Photometric Gain from Gain-Model V(T) fit

Detector A: `G3 = 0.00766/(1.14351+0.0085*T) (V/K)`
Detector B: `G3 = 0.00850/(1.12905+0.0077*T) (V/K)`
Detector C: `G3 = 0.00920/(1.19280+0.0120*T) (V/K)`
Detector D: `G3 = 0.00887/(1.18225+0.0108*T) (V/K)`

6.1.3 Linearity

See RCA25_LIS.pdf

6.1.4 Consistency of the Results based on SKY steps

The white noise limit has been calculated and compared with the requirement. The white noise limit is defined at a given SKY temperature as follows:

Eq. 1:

$$\Delta T = \sqrt{2} \cdot \frac{T_{SKY} + T_{SYS}}{\sqrt{B}} \cdot 1000 \left[\mathrm{mK} \cdot \sqrt{\mathrm{sec}} \right]$$

where B is the bandwidth [Hz], τ is the integration time [sec], T_{SKY} and T_{SYS} are the Skyload antenna temperature [K] and noise system temperature [K] respectively.
From measurements the white noise limit is calculated as follows:

Eq. 2:

$$\Delta T = G[K/V] \cdot \frac{1}{\sqrt{2}} \cdot WN \cdot \sqrt{\frac{\tau}{\tau - \tau_{BT}}}$$

where *WN* is the white noise as derived from RaNA, τ is the 122 microSec (1/8KHz) integration time and τ_{BT} is the blanking time (7.5 microSec). G is the gain (K/V) which needs to be know from RCA_TNG tests.

The requirements has been calculated assuming Tsys = 16.6 Kelvin and B = 8.8 GHz (see XXX), while the white noise limit form measurements has been derived in three ways:

1. From the Tsys and B derived from tests applying Eq. 1. Tsys values were obtained from the gain-model fit V(T) and B were obtained from RCA_SPR test
2. Directly From WN measurements applying the Eq. 2, where *WN* is the white noise level derived from RaNA FFT module. Firstly the white noise limit has been derived form *RaNA_FFT* module selecting a stable (~600 sec) calibrated acquisition data chunk. The White noise of differenced calibrated[1] detectors has been selected (A–B and C–D). Then the number has been corrected by the Blanking time.
3. White noise derived from B obtained from WN level (from RaNA FFT) and Tsys from LIS results.

Note that the consistency check has been repeated also using data with SKY = 20K and REF = 20K. Moreover the consistency check has been performed also using the noise temperatures derived from linear extrapolation at Tin = 0.

Table 6-7: *white noise as derived from measurements **(Tsys, B from SPR, calibrated WN)** compared with the requirements*

	Requirement	From Measured Tsys & B	Ratio over requirement	From Data After calibration	Ratio over requirement	Consistency ratio
	mK*Sqrt(s)	mK*Sqrt(s)		mK*Sqrt(s)		
SKY = 10.5 K REF = 8 K						
Detector A B	0.35564120	0.47482853	1.34	0.47338609	1.33	1.00
Detector C D		0.49728092	1.40	0.42825619	1.20	0.86
SKY = 20 K REF = 20 K						
Detector A B	0.53612862	0.71332009	1.33	0.63655285	1.19	0.89
Detector C D		0.75094818	1.41	0.57772631	1.08	0.77

Table 6-8: *white noise as derived from measurements (**Tsys, B from WN diff, calibrated WN**) compared with the requirements*

	Requirement	From Measured Tsys & B	Ratio over requirement	From Data After calibration	Ratio over requirement	Consistency ratio
	mK*Sqrt(s)	mK*Sqrt(s)		mK*Sqrt(s)		
SKY = 10.5 K REF = 8 K						
Detector A B	0.35564120	0.43428372	1.22	0.47338609	1.33	1.09
Detector C D		0.39943288	1.12	0.42825619	1.20	1.07
SKY = 20 K						

[1] The calibration has been obtained in the following way:

REF = 20 K						
Detector A B	0.53612862	0.60226832	1.12	0.63655285	1.19	1.06
Detector C D		0.55183196	1.03	0.57772631	1.08	1.05

Expected White noise at Flight conditions has been calculated using with Tnoise gain-model V(T) fit and B derived from SPR tests. Here the results:

Table 6-9: *white noise extrapolated at Flight conditions (SKY = 2.73 K) compared* ***(Tsys from Gain-Model V(T) fit, B from WN)*** *compared with the requirements*

	Requirement	From Measured Tsys & B	Ratio over requirement	From Data After calibration	Ratio over requirement	Consistency ratio
	mK*Sqrt(s)	mK*Sqrt(s)		mK*Sqrt(s)		
EXTRAPOLATED AT FLIGHT CONDITIONS						
Detector A B	0.28141600	0.31809579	1.13	N/A	N/A	N/A
Detector C D		0.28876590	1.03	N/A	N/A	N/A

Tsys that gives consistency ratio = 1 (beta from SPR test, value is an average of both channels)					
beta-A (GHz)	5.9100				
beta-B (GHz)	4.17				
beta A-B (GHz)	5.04				
Optimal noise temperature	16.60000000	1.00600000			
beta that gives consistency ratio = 1 (Tsys from gain-model fit, value is an average of both channels)					
Tsys-A (K)	16.83686				
Tsys-B (K)	16.85441				
Tsys A-B (K)	16.845635				
Optimal eff bandwidth	5.1	1.00300000			

Tsys that gives consistency ratio = 1 (beta from SPR test, value is an average of both channels)					
beta-C (GHz)	4.4200				
beta-D (GHz)	4.49				
beta C-D (GHz)	4.45500				
Optimal noise temperature	12.50000000	1.00000000			
beta that gives consistency ratio = 1 (Tsys from gain-model fit, value is an average of both channels)					
Tsys-C (K)	16.129				
Tsys-D (K)	16.8296				
Tsys C-D (K)	16.4793				
Optimal eff bandwidth	6.0	0.99900000			

6.1.5 Consistency of the Results based on REF steps

Table 6-10: *white noise as derived from measurements* ***(Tsys, B from SPR, calibrated WN)*** *compared with the requirements*

	Requirement	From Measured Tsys & B	Ratio over requirement	From Data After calibration	Ratio over requirement	Consistency ratio
	mK*Sqrt(s)	mK*Sqrt(s)		mK*Sqrt(s)		
SKY = 10.5 K REF = 8 K						
Detector A B	0.35564120	0.50591852	1.42	0.48465993	1.36	0.96
Detector C D		0.51817552	1.46	0.43009999	1.21	0.83
SKY = 20 K REF = 20 K						
Detector A B	0.53612862	0.74441008	1.39	0.65128649	1.21	0.87
Detector C D		0.77184279	1.44	0.58215614	1.09	0.75

Table 6-11: *white noise as derived from measurements (****Tsys, B from WN diff, calibrated WN****) compared with the requirements*

	Requirement	From Measured Tsys & B	Ratio over requirement	From Data After calibration	Ratio over requirement	Consistency ratio
	mK*Sqrt(s)	mK*Sqrt(s)		mK*Sqrt(s)		
SKY = 10.5 K REF = 8 K						
Detector A B	0.35564120	0.46271899	1.30	0.48465993	1.36	1.05
Detector C D		0.41621613	1.17	0.43009999	1.21	1.03
SKY = 20 K REF = 20 K						
Detector A B	0.53612862	0.62851813	1.17	0.65128649	1.21	1.04
Detector C D		0.56718630	1.06	0.58215614	1.09	1.03

Expected White noise at Flight conditions has been calculated using **Errore. L'origine riferimento non è stata trovata.** with Tnoise gain-model V(T) fit and B derived from SPR tests. Here the results:

Table 6-12: *white noise extrapolated at Flight conditions (SKY = 2.73 K) compared* ***(Tsys from Gain-Model V(T) fit, B from WN)*** *compared with the requirements*

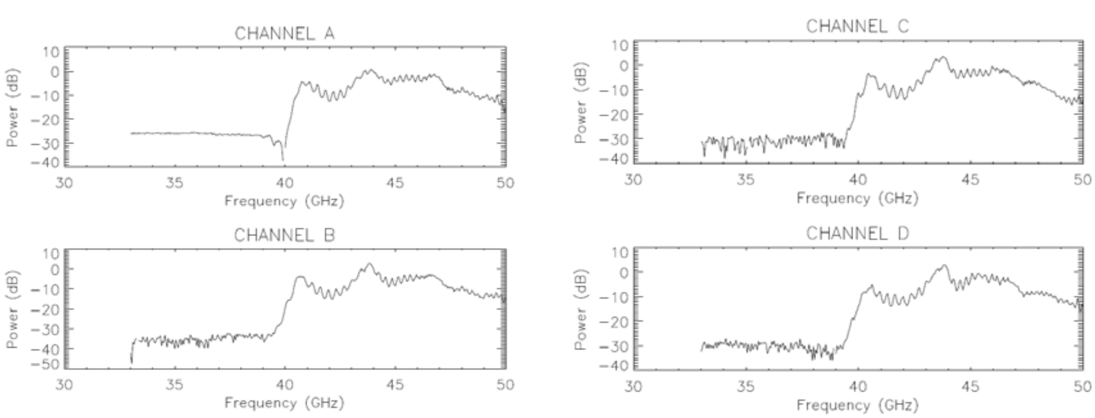
	Requirement	From Measured Tsys & B	Ratio over requirement	From Data After calibration	Ratio over requirement	Consistency ratio
	mK*Sqrt(s)	mK*Sqrt(s)		mK*Sqrt(s)		
EXTRAPOLATED AT FLIGHT CONDITIONS						
Detector A B	0.28141600	0.34434560	1.22	N/A	N/A	N/A
Detector C D		0.30412024	1.08	N/A	N/A	N/A

Tsys that gives consistency ratio = 1 (beta from SPR test, value is an average of both channels)					
beta-A (GHz)	5.9100				
beta-B (GHz)	4.17				
beta A-B (GHz)	5.04				
Optimal noise temperature	17.00000000	1.00500000			
beta that gives consistency ratio = 1 (Tsys from gain-model fit, value is an average of both channels)					
Tsys-A (K)	18.17818				
Tsys-B (K)	18.6345				
Tsys A-B (K)	18.40634				
Optimal eff bandwidth	5.5	1.00700000			

Tsys that gives consistency ratio = 1 (beta from SPR test, value is an average of both channels)					
beta-C (GHz)	4.4200				
beta-D (GHz)	4.49				
beta C-D (GHz)	4.45500				
Optimal noise temperature	12.25000000	1.00400000			
beta that gives consistency ratio = 1 (Tsys from gain-model fit, value is an average of both channels)					
Tsys-C (K)	17.37273				
Tsys-D (K)	17.55817				
Tsys C-D (K)	17.46545				
Optimal eff bandwidth	6.5	1.00300000			

6.2 RCA_SPR: Bandpass measurement

Summary is reported in RCA25_SPR_1600.pdf
The results are summarized here:



There is an offset problem on channel A that could overestimate the bandwidth of this channel. A detail study of this effect is on-going.

Table 6-13: *RCA_SPR main results.*

	Central Frequency (GHz)	Equivalent Bandwidth (GHz)
Detector A	44.90	5.91
Detector B	45.85	4.17
Detector C	45.75	4.42
Detector D	45.25	4.49

7 NOISE PROPERTIES

7.1 RCA_STN

STn test has been performed both for phase switch on channel M1/S1 and M2/S2 as to investigate symmetries.

7.1.1 4kHz switching on M1/S1

Long acquisition time has been performed with the aim to derive noise spectra. The data set analysed are:
044LFI25_RCA_FM_ST3_200605181920
044LFI25_RCA_FM_ST3_200605190355

The temperature step sequence is reported in Table 7-1.

Table 7-1: Reference Temperature steps for Noise properties test (STn)

SKY Temperature	REF Temperature	Duration
10.5 K	8.0 K	≤ 3 hours
11.0 K	15.0 K	≤ 3 hours
11.2 K	20.0 K	≤ 3 hours
20.0 K	20.0 K	≤ 3 hours

RaNA reports have been uploaded on max.iasfbo.inaf.it (directory RCA025 Docs).

7.1.1.1 One–Over–F Noise

A fourier transform has been applied on data to obtain the 1/f knee frequency and noise properties. The following data set have been used:

[2] Thanks to ESA – ESTEC
[3] Thanks to Segio Mariotti INAF/IRA - Bologna
[4] Thanks to ESA – ESTEC

10.5 / 8.0 Selected from **7200 – 10800** sec, bin 10 for FFT and 1/f from file
`044LFI25_RCA_FM_ST3_200605181920`
11.0 / 15.0 Selected from **17900 – 21500** sec, bin 10 for FFT and 1/f from file
`044LFI25_RCA_FM_ST3_200605181920`
11.2 / 20.0 Selected from **27000 – 30600** sec , bin 10 for FFT and 1/f from file
`044LFI25_RCA_FM_ST3_200605181920`
20.0 / 20.0 Selected from **19400 – 23000** sec, bin 10 for FFT and 1/f from file
`044LFI25_RCA_FM_ST3_200605190355`

In the following table the 1/f characteristics obtained by an optimized fitting is reported. The numbers of point used for the low frequency fit is reported for each detector. BIN = 10 is used (fsampl =409.600).

T sky = 10.5 K T ref = 8.0 K	Detector A	Detector B	Detector C	Detector D
N points	53	53	53	25
1/f knee frequency	0.010516714	0.023660445	0.023824874	0.011375346
R factor	1.0436863	1.0396388	1.0397661	1.0450748
1/f Slope	-0.94395202	-0.97695062	-0.98607429	-0.83907391

T sky = 11.0 K T ref = 15.0 K	Detector A	Detector B	Detector C	Detector D
N points	90	31	46	37
1/f knee frequency	0.025250720	0.0178765	0.0179022	0.018131704
R factor	0.87991557	0.87605257	0.88477145	0.88909587
1/f Slope	-1.0300975	-0.945251	-0.982794	-1.1358883

T sky = 11.2 K T ref = 20.0 K	Detector A	Detector B	Detector C	Detector D
N points	100	100	100	100
1/f knee frequency	0.034420479	0.025147609	0.039282668	0.043440990
R factor	0.80887303	0.80469791	0.81886386	0.82248744
1/f Slope	-1.2393608	-1.1802476	-1.1579224	-1.0876688

T sky = 20.0 K T ref = 20.0 K	Detector A	Detector B	Detector C	Detector D
N points	22	50	22	40
1/f knee frequency	0.010734703	0.0111339	0.019024844	0.013390471
R factor	0.98201972	0.98086981	0.97952690	0.98513828
1/f Slope	-0.79388733	-0.497261	-0.89865325	-0.80295615

7.1.1.2 White Noise Level and Equivalent Bandwidth

The white noise level has been calculated with the *RaNA_FFT* module using the high frequency part of the amplitude spectrum. From the white noise limit the equivalent bandwidth has been derived. Same data stream as the 1/f calculation has been used. Data were not binned and 10 minutes have been taken for each reference temperature step. For each step the last 600 seconds of the data taken for 1/f noise have been taken for this analysis.

T sky = 10.5 K T ref = 8.0 K	White noise level [V/Sqrt(Hz)]			Effective bandwidth [GHz]		
	Sky	*Load*	*Diff*	*Sky*	*Load*	*Diff*

DETECTOR A	3.9261940e-006	3.7706452e-006	5.5503204e-006	7.00	6.97	7.01
DETECTOR B	5.2720633e-006	5.0191523e-006	7.4160007e-006	4.98	5.09	5.04
DETECTOR C	4.3518511e-006	4.1894667e-006	6.1527110e-006	6.88	6.87	6.89
DETECTOR D	4.3836212e-006	4.1628118e-006	6.1779480e-006	6.87	6.98	6.92

T sky = 11.0 K T ref = 15.0 K	White noise level [V/Sqrt(Hz)]			Effective bandwidth [GHz]		
	Sky	*Load*	*Diff*	*Sky*	*Load*	*Diff*
DETECTOR A	4.0123085e-006	4.3075149e-006	5.5164725e-006	7.08	7.93	7.49
DETECTOR B	5.3630112e-006	5.8077719e-006	7.3862621e-006	5.07	5.63	5.35
DETECTOR C	4.4383118e-006	4.7304208e-006	6.1097743e-006	6.99	7.86	7.38
DETECTOR D	4.4644086e-006	4.7820458e-006	6.1653777e-006	7.01	7.72	7.35

T sky = 11.2 K T ref = 20.0 K	White noise level [V/Sqrt(Hz)]			Effective bandwidth [GHz]		
	Sky	*Load*	*Diff*	*Sky*	*Load*	*Diff*
DETECTOR A	4.0701811e-006	4.7781284e-006	5.6095932e-006	7.29	8.06	7.67
DETECTOR B	5.4266784e-006	6.2675246e-006	7.4074544e-006	5.24	6.05	5.62
DETECTOR C	4.5458811e-006	5.0844118e-006	6.1642602e-006	7.05	8.39	7.67
DETECTOR D	4.5189476e-006	5.0840219e-006	6.1660806e-006	7.24	8.44	7.77

T sky = 20.0 K T ref = 20.0 K	White noise level [V/Sqrt(Hz)]			Effective bandwidth [GHz]		
	Sky	*Load*	*Diff*	*Sky*	*Load*	*Diff*
DETECTOR A	4.7889175e-006	4.6703527e-006	6.6236233e-006	7.86	8.57	8.22
DETECTOR B	6.3479494e-006	6.3351423e-006	8.8713764e-006	5.78	6.03	5.92
DETECTOR C	5.1240884e-006	5.1324457e-006	7.1812275e-006	8.09	8.40	8.24
DETECTOR D	5.1534072e-006	5.1339909e-006	7.2266061e-006	8.12	8.43	8.26

7.1.2 4kHz switching on M2/S2

Long acquisition time has been performed with the aim to derive noise spectra. The data set analysed are:
`044LFI25_RCA_FM_ST3_200605191847`
`044LFI25_RCA_FM_ST3_200605200327`

The temperature step sequence is reported in Table 7-1.

Table 7-2: Reference Temperature steps for Noise properties test (STn)

SKY Temperature	REF Temperature	Duration
10.5 K	8.0 K	≤ 3 hours
11.0 K	15.0 K	≤ 3 hours
11.8 K	20.0 K	≤ 3 hours
20.0 K	20.0 K	≤ 3 hours

RaNA reports have been uploaded on max.iasfbo.inaf.it (directory RCA025 Docs).

7.1.2.1 One–Over–F Noise

A fourier transform has been applied on data to obtain the 1/f knee frequency and noise properties. The following data set have been used:

10.5 / 8.0 Selected from **7100 – 10700** sec, bin 10 for FFT and 1/f from file
`044LFI25_RCA_FM_ST3_200605191847`
11.0 / 15.0 Selected from **17800 – 21400** sec, bin 10 for FFT and 1/f from file
`044LFI25_RCA_FM_ST3_200605191847`
11.2 / 20.0 Selected from **27000 – 30600** sec , bin 10 for FFT and 1/f from file
`044LFI25_RCA_FM_ST3_200605191847`
20.0 / 20.0 Selected from **19000 – 22600** sec, bin 10 for FFT and 1/f from file
`044LFI25_RCA_FM_ST3_200605200327`

In the following table the 1/f characteristics obtained by an optimized fitting is reported. The numbers of point used for the low frequency fit is reported for each detector. BIN = 10 is used (`fsampl =409.600`).

T sky = 10.5 K T ref = 8.0 K	Detector A	Detector B	Detector C	Detector D
N points	19	19	49	43
1/f knee frequency	0.0047304590	0.0095577413	0.018027259	0.0219002
R factor	1.0412120	1.0408503	1.0288710	1.0589843
1/f Slope	-0.88591810	-0.85855637	-1.1240666	-1.28016

T sky = 11.0 K T ref = 15.0 K	Detector A	Detector B	Detector C	Detector D
N points	17	44	22	80
1/f knee frequency	0.015153034	0.0130549	0.0248488	0.0203416
R factor	0.87677074	0.87603497	0.87557050	0.90053544
1/f Slope	-1.0434849	-1.01460	-1.06759	-0.931436

T sky = 11.2 K T ref = 20.0 K	Detector A	Detector B	Detector C	Detector D
N points	100	100	70	60
1/f knee frequency	0.036881693	0.036198000	0.035724396	0.037098859
R factor	0.80554513	0.80433787	0.81045024	0.83289638
1/f Slope	-1.0727899	-1.1014008	-1.0590718	-1.0943250

T sky = 20.0 K T ref = 20.0 K	Detector A	Detector B	Detector C	Detector D
N points	30	30	100	50
1/f knee frequency	0.012638429	0.0085212576	0.012390460	0.0106418
R factor	0.97991426	0.98122846	0.97057132	0.99793510
1/f Slope	-0.83478059	-0.74100597	-0.86817151	-0.630170

7.1.2.2 White Noise Level and Equivalent Bandwidth

The white noise level has been calculated with the *RaNA_FFT* module using the high frequency part of the amplitude spectrum. From the white noise limit the equivalent bandwidth has been derived. Same data stream as the 1/f calculation has been used. Data were not binned and 10 minutes have been taken for each reference temperature step. For each step the last 600 seconds of the data taken for 1/f noise have been taken for this analysis.

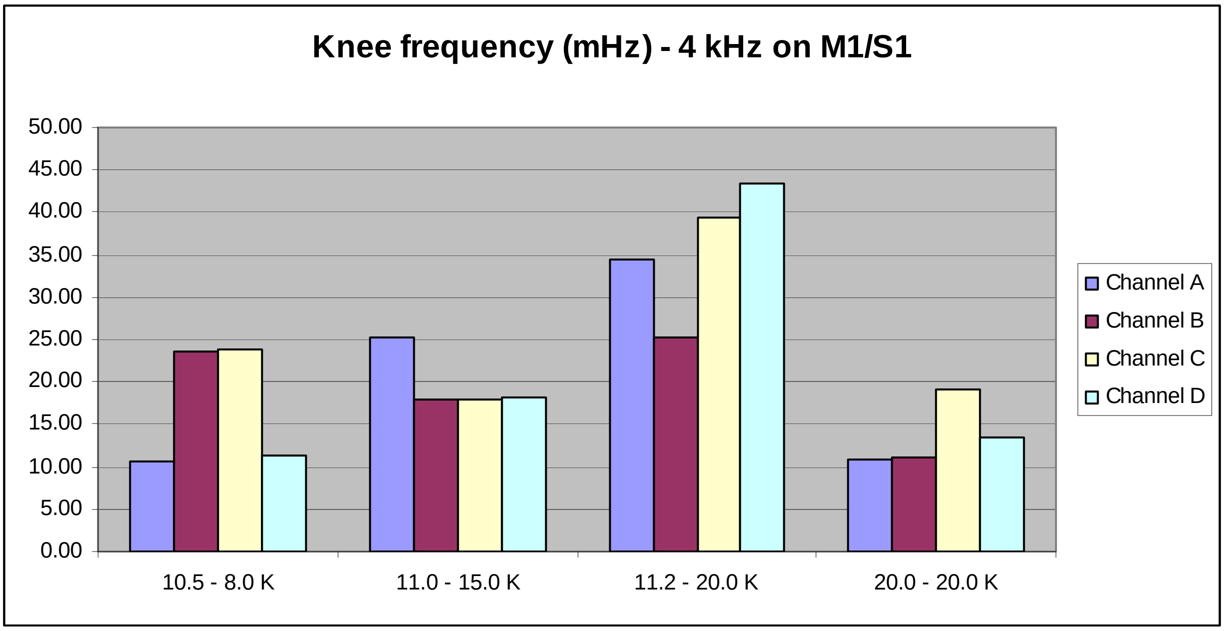
T sky = 10.5 K T ref = 8.0 K	White noise level [V/Sqrt(Hz)]			Effective bandwidth [GHz]		
	Sky	*Load*	*Diff*	*Sky*	*Load*	*Diff*

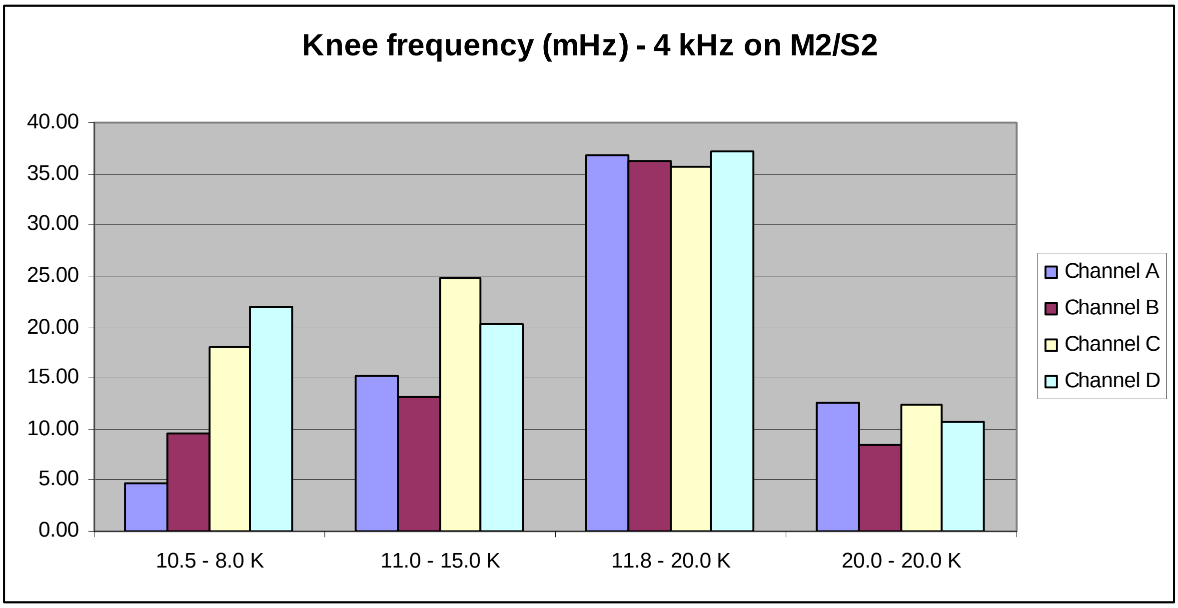
DETECTOR A	3.9896729e-006	3.7934427e-006	5.6114976e-006	6.75	6.89	6.82
DETECTOR B	5.3047069e-006	5.0644272e-006	7.4819674e-006	4.94	5.00	4.96
DETECTOR C	4.3943584e-006	4.2159649e-006	6.1630940e-006	6.76	6.94	6.87
DETECTOR D	4.4712810e-006	4.1977985e-006	6.2865945e-006	6.80	6.88	6.88

T sky = 11.0 K T ref = 15.0 K	White noise level [V/Sqrt(Hz)]			Effective bandwidth [GHz]		
	Sky	*Load*	*Diff*	*Sky*	*Load*	*Diff*
DETECTOR A	4.0283197e-006	4.3441153e-006	5.5474188e-006	6.97	7.80	7.35
DETECTOR B	5.3700218e-006	5.8377617e-006	7.4217332e-006	5.07	5.58	5.31
DETECTOR C	4.4632934e-006	4.7688702e-006	6.1248291e-006	6.91	7.89	7.34
DETECTOR D	4.5243587e-006	4.8171386e-006	6.2666826e-006	7.02	7.63	7.31

T sky = 11.2 K T ref = 20.0 K	White noise level [V/Sqrt(Hz)]			Effective bandwidth [GHz]		
	Sky	*Load*	*Diff*	*Sky*	*Load*	*Diff*
DETECTOR A	4.0655313e-006	4.7933802e-006	5.6067105e-006	7.24	8.01	7.62
DETECTOR B	5.4383850e-006	6.3467385e-006	7.4565302e-006	5.23	5.92	5.56
DETECTOR C	4.5598769e-006	5.1254642e-006	6.1667095e-006	6.99	8.41	7.64
DETECTOR D	4.5944623e-006	5.1243207e-006	6.2828882e-006	7.19	8.32	7.69

T sky = 20.0 K T ref = 20.0 K	White noise level [V/Sqrt(Hz)]			Effective bandwidth [GHz]		
	Sky	*Load*	*Diff*	*Sky*	*Load*	*Diff*
DETECTOR A	4.8056881e-006	4.6744742e-006	6.6335184e-006	7.78	8.56	8.16
DETECTOR B	6.3620178e-006	6.3993873e-006	8.9362055e-006	5.78	5.93	5.86
DETECTOR C	5.1610502e-006	5.1668449e-006	7.1878295e-006	7.97	8.44	8.21
DETECTOR D	5.2103505e-006	5.1573417e-006	7.3174940e-006	8.16	8.36	8.27





7.2 RCA_UNC: UNCHOPPED DATA

Noise properties have been derived also from unchopped data, i.e. with all the phase switches off. The knee frequencies reported in the tables below are in Hz. The following data set have been analysed:

- 044LFI25_RCA_FM_UNC_200605191202
- 044LFI25_RCA_FM_UNC_200605191246
- 044LFI25_RCA_FM_UNC_200605191342
- 044LFI25_RCA_FM_UNC_200605191441

The corresponding RaNA report sare available on max server (max.iasfbo.inaf.it).

7.2.1 PS/SW ln1 diode reverse, ln2 diode forward on all channels

10.9 / 8.0 Selected from **50** – **2450** sec, bin 10 for FFT and 1/f from file 044LFI25_RCA_FM_UNC_200605191202

T sky = 13.0 K T ref = 8.5 K	Detector A	Detector B	Detector C	Detector D
		SKY		
N points	30000	37	30000	44
1/f knee frequency	14.403801[5]	29.9906	19.8833	33.1539
1/f Slope	-0.74162818	-0.755692	-0.685979	-0.667751
		REF		
N points	30000	37		
1/f knee frequency	14.6886	39.7850	20.0638	21.8985
1/f Slope	-0.738654	-0.731333	-0.686840	-0.660918

[5] The red values are underestimated because the right number of points has not been found.

The white noise level has been calculated with the *RaNA_FFT* module using the high frequency part of the amplitude spectrum. From the white noise limit the equivalent bandwidth has been derived. Same data stream as the 1/f calculation has been used. Data were not binned and 10 minutes have been taken for each reference temperature step. For each step the last 600 seconds of the data taken for 1/f noise have been taken for this analysis.

T sky = 13.0 K T ref = 8.5 K	White noise level [V/Sqrt(Hz)]			Effective bandwidth [GHz]		
	Sky	*Load*	*Diff*	*Sky*	*Load*	*Diff*
DETECTOR A	3.8177859e-006	3.8184308e-006	5.3982691e-006	6.93	6.93	6.94
DETECTOR B	5.4974387e-006	5.4895444e-006	7.7847206e-006	5.17	5.19	5.16
DETECTOR C	4.5723670e-006	4.5643786e-006	6.4601131e-006	6.98	7.00	6.99
DETECTOR D	4.2121663e-006	4.2157433e-006	5.9478368e-006	7.01	6.99	7.03

7.2.2 PS/SW ln1 diode reverse, ln2 diode forward on Channels M2/S2; ln1 diode forward, ln2 diode reverse on Channels M1/S1

10.5 / 8.0 Selected from **50** – **3050** sec, bin 10 for FFT and 1/f from file
`044LFI25_RCA_FM_UNC_200605191246`

T sky = 10.5 K T ref = 8.0 K	Detector A	Detector B	Detector C	Detector D
		SKY		
N points	30000	30000	32	30000
1/f knee frequency	13.945311	12.172465	166.62519	20.938829
1/f Slope	-0.75716635	-0.71929293	-0.64926289	-0.66001421
		REF		
N points	30000	30000	32	30000
1/f knee frequency	14.199085	12.326361	84.536024	20.930331
1/f Slope	-0.75641171	-0.70943754	-0.69140536	-0.66219999

The white noise level has been calculated with the *RaNA_FFT* module using the high frequency part of the amplitude spectrum. From the white noise limit the equivalent bandwidth has been derived. Same data stream as the 1/f calculation has been used. Data were not binned and 10 minutes have been taken for each reference temperature step. For each step the last 600 seconds of the data taken for 1/f noise have been taken for this analysis.

T sky = 10.5 K T ref = 8.0 K	White noise level [V/Sqrt(Hz)]			Effective bandwidth [GHz]		
	Sky	*Load*	*Diff*	*Sky*	*Load*	*Diff*
DETECTOR A	4.0190481e-006	4.0346009e-006	5.6842554e-006	7.05	7.00	7.05
DETECTOR B	5.1117798e-006	5.1149090e-006	7.2316124e-006	5.12	5.12	5.12
DETECTOR C	4.2804437e-006	4.2536946e-006	6.0344549e-006	6.78	6.87	6.83
DETECTOR D	4.4748793e-006	4.4804996e-006	6.3204366e-006	6.93	6.91	6.95

7.2.3 PS/SW ln1 diode forward, ln2 diode reverse on all channels

13.0 / 8.5 Selected from **50** – **3350** sec, bin 10 for FFT and 1/f from file
`044LFI25_RCA_FM_UNC_200605191342`

T sky = 10.5 K T ref = 8.0 K	Detector A	Detector B	Detector C	Detector D
	SKY			
N points	41	14	31	32
1/f knee frequency	53.4216	35.0257	52.8597	81.7439
1/f Slope	-0.723392	-0.779242	-0.740832	-0.640833
	REF			
N points	41	14	31	32
1/f knee frequency	51.0993	30.3707	113.128	157.466
1/f Slope	-0.727320	-0.788928	-0.685558	-0.599572

The white noise level has been calculated with the *RaNA_FFT* module using the high frequency part of the amplitude spectrum. From the white noise limit the equivalent bandwidth has been derived. Same data stream as the 1/f calculation has been used. Data were not binned and 10 minutes have been taken for each reference temperature step. For each step the last 600 seconds of the data taken for 1/f noise have been taken for this analysis.

T sky = 10.5 K T ref = 8.0 K	White noise level [V/Sqrt(Hz)]			Effective bandwidth [GHz]		
	Sky	*Load*	*Diff*	*Sky*	*Load*	*Diff*
DETECTOR A	3.8232492e-006	3.8175648e-006	5.4096910e-006	7.10	7.12	7.09
DETECTOR B	5.3203804e-006	5.3121512e-006	7.5179271e-006	5.18	5.20	5.19
DETECTOR C	4.4829167e-006	4.4856775e-006	6.3451152e-006	6.97	6.96	6.96
DETECTOR D	4.2514357e-006	4.2554477e-006	6.0134052e-006	7.15	7.14	7.15

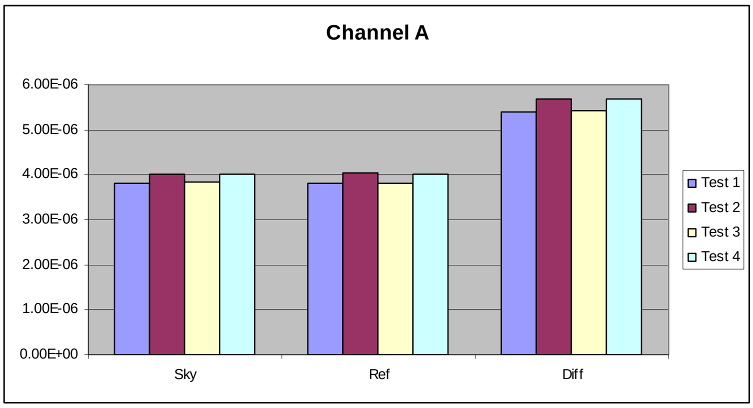
7.2.4 PS/SW ln1 diode reverse, ln2 diode forward on Channels M1/S1; ln1 diode forward, ln2 diode reverse on Channels M2/S2

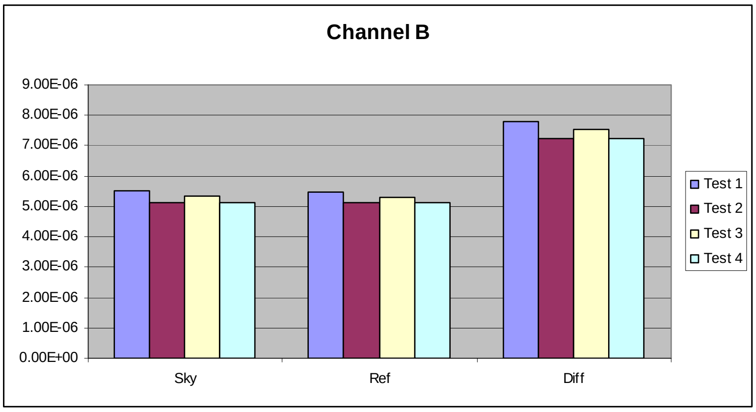
13.0 / 8.5 Selected from **0** – **3000** sec, bin 10 for FFT and 1/f from file
`044LFI25_RCA_FM_UNC_200605191441`

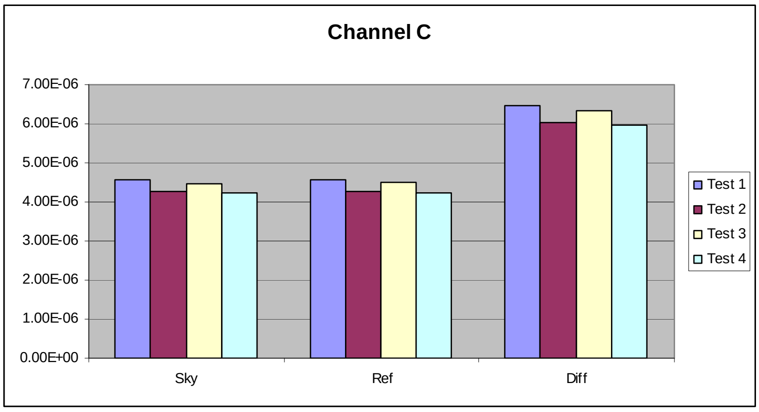
T sky = 13.0 K T ref = 8.5 K	Detector A	Detector B	Detector C	Detector D
		SKY		
N points	43	18	45	24
1/f knee frequency	157.21152	462.165	166.480	75.4817
1/f Slope	-0.61160166	-0.572220	-0.606649	-0.644112
		REF		
N points	44	18	46	24
1/f knee frequency	96.436066	245.102	91.3560	198.413
1/f Slope	-0.64071303	-0.603175	-0.649805	-0.584125

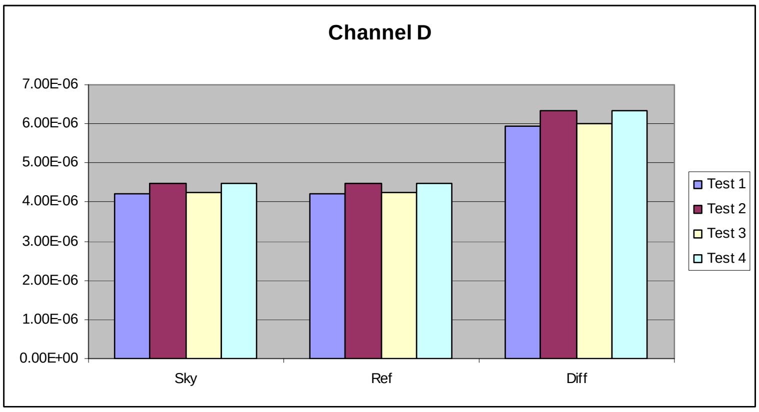
The white noise level has been calculated with the *RaNA_FFT* module using the high frequency part of the amplitude spectrum. From the white noise limit the equivalent bandwidth has been derived. Same data stream as the 1/f calculation has been used. Data were not binned and 10 minutes have been taken for each reference temperature step. For each step the last 600 seconds of the data taken for 1/f noise have been taken for this analysis.

T sky = 13.0 K T ref = 8.5 K	White noise level [V/Sqrt(Hz)]			Effective bandwidth [GHz]		
	Sky	*Load*	*Diff*	*Sky*	*Load*	*Diff*
DETECTOR A	4.0200618e-006	4.0069063e-006	5.6718627e-006	6.86	6.90	6.89
DETECTOR B	5.1196761e-006	5.1281481e-006	7.2557033e-006	5.03	5.01	5.01
DETECTOR C	4.2273930e-006	4.2335806e-006	5.9829269e-006	7.08	7.06	7.07
DETECTOR D	4.4845856e-006	4.4763399e-006	6.3247848e-006	6.99	7.01	7.02


Channel A
6.00E-06
5.00E-06
4.00E-06
3.00E-06
2.00E-06
1.00E-06
0.00E+00
Sky
Ref
Diff
Test 1
Test 2
Test 3
Test 4


Channel B
9.00E-06
8.00E-06
7.00E-06
6.00E-06
5.00E-06
4.00E-06
3.00E-06
2.00E-06
1.00E-06
0.00E+00
Sky
Ref
Diff
Test 1
Test 2
Test 3
Test 4


Channel C
7.00E-06
6.00E-06
5.00E-06
4.00E-06
3.00E-06
2.00E-06
1.00E-06
0.00E+00
Sky
Ref
Diff
Test 1
Test 2
Test 3
Test 4


Channel D
7.00E-06
6.00E-06
5.00E-06
4.00E-06
3.00E-06
2.00E-06
1.00E-06
0.00E+00
Sky
Ref
Diff
Test 1
Test 2
Test 3
Test 4

7.3 Spikes investigation

The following data have been selected:

- **8640 – 10800** sec (bin 10) from file `044LFI25_RCA_FM_ST3_200605181920`
- **0 – 2160** sec (bin 10) from file `044LFI25_RCA_FM_XXX_200605240937`

In the XXX data set all connectors from temperature controllers have been removed and this has no effect on spikes, that are probably due (as in the 30 GHz) to the temperature acquisition system.

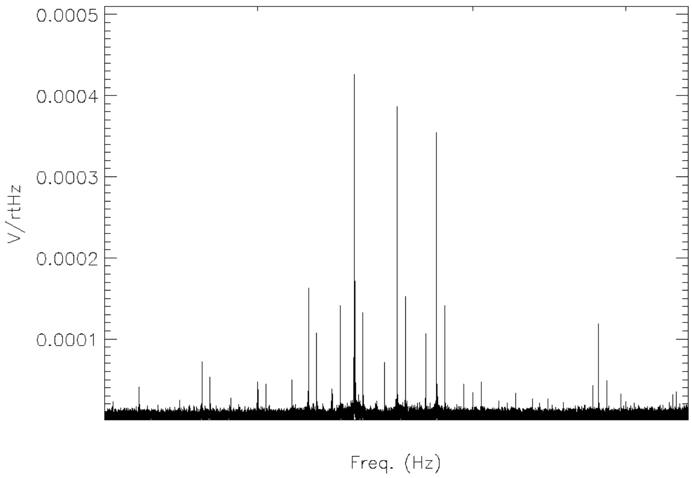


Figure 5 044LFI25_RCA_FM_ST3_200605181920 data set**:** Sky – r Ref.

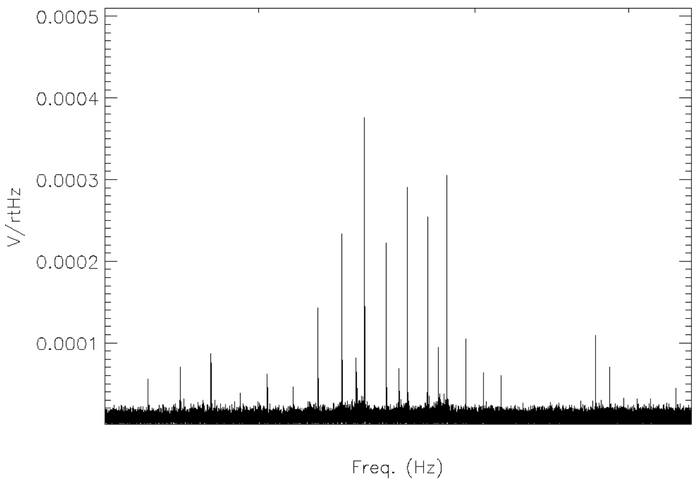


Figure 6 044LFI25_RCA_FM_XXX_200605240937 data set**:** Sky – r Ref.

8 SUSCEPTIBILIY TESTS

8.1 SUSCEPTIBILITY TESTS

Any thermal and electrical variation on the RCA subsystem units produces a variation of the output signal from each of the four detector.

8.2 RCA_THF: Susceptibility to FEM temperature variations

The test has been performed by varying the temperature of the FEM keeping constant the temperatures of the other thermal interfaces.
The temperature of the FEM has been set to 20K (nominal), 22K, 24K, and 27K as seen in Figure -1

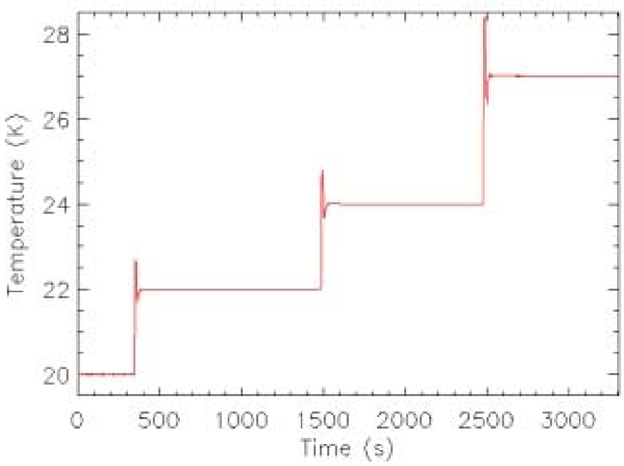


Figure -7: *FEM temperature step during the RCA_THF test*

The temperature behaviour of the other thermal interfaces are reported in the next figures (Figure -2 and Figure -3) showing the sky load (SKY_TEMP and SMON_TMP) and reference load temperatures, and the BEM temperature.

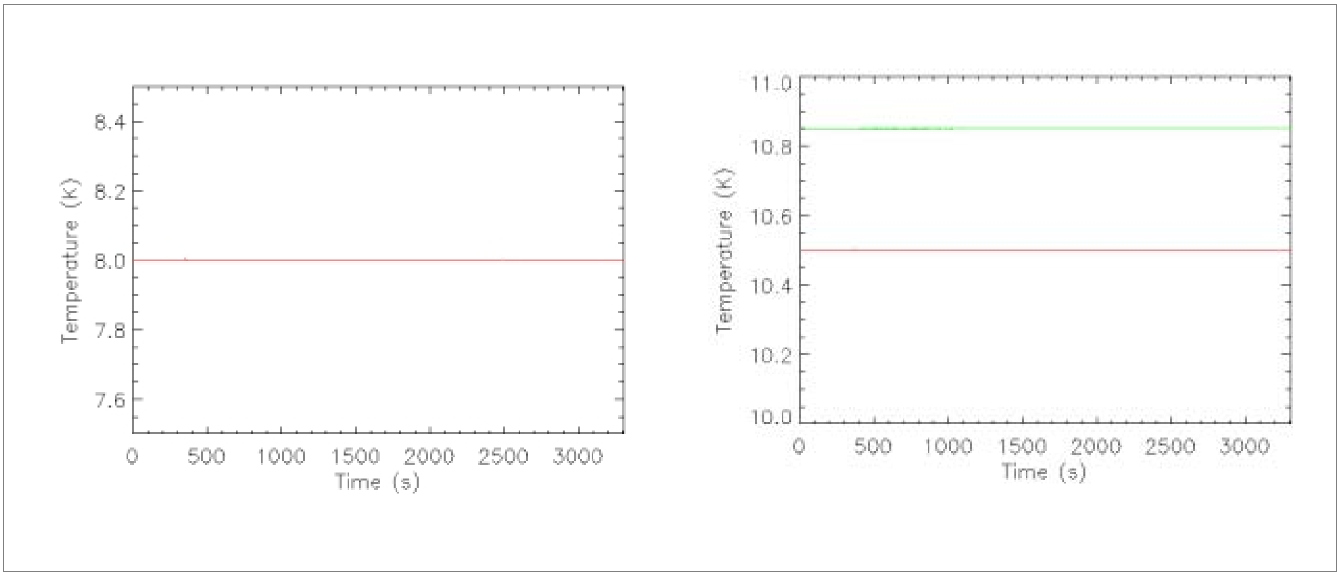


Figure -8*: Left – Reference Load temperature behaviour during the RCA_THF test; right – SKY_TEMP probe (red) and SMON_TMP probe (green)*

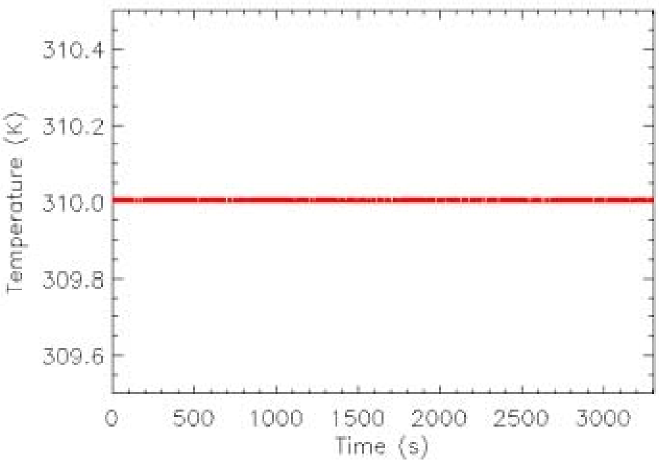
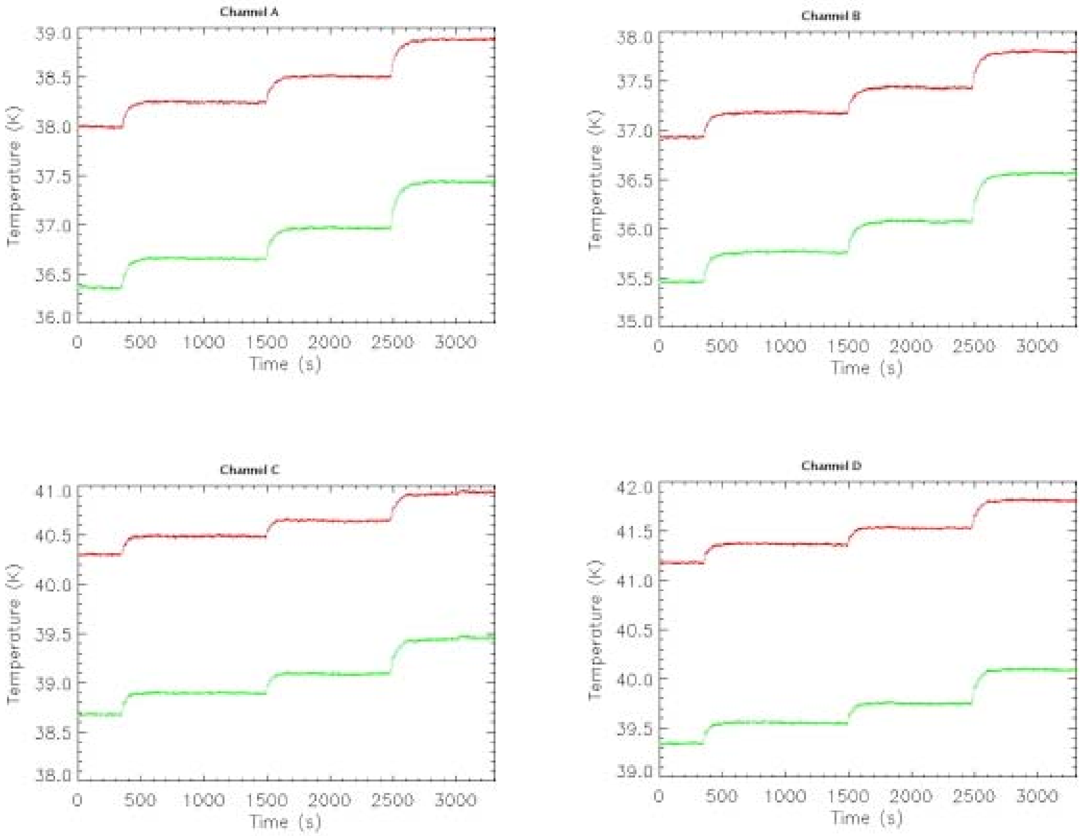


***Figure -9:** BEM temperature behaviour during the RCA_THF test*

To do the analysis, the radiometric output for each channel in the three steps was recorded. We can see the output of the channels in the figures below:

***Figure -10:** Radiometric output of the 4 detectors during the RCA_THF test. Sky (red) and Ref (green)*



Analysis using the SKY_TEMP probe as sky load temperature:

The default parameters for the four channels are:

	Ch. A	Ch. B	Ch. C	Ch. D
Freq. (*GHz*)	44			
$L_{feed-OMT}$ (*dB*)	0.1			
L_{4k} (*dB*)	0.1			
r	1.044862	1.0414686	1.0419499	1.0466342
T_{sky} (*K*)	10.5			
T_{ref} (*K*)	7.9999			
G^{dB}_{F1} (*dB*)	35			
G^{dB}_{F2} (*dB*)	35			
T_{nF1} (*K*)	20	20	20	20
T_{nF2} (*K*)	20	20	20	20
$\partial G^{dB}_{F1} / \partial T^{FE}_{phys}$ (*dB/K*)	-0.05	-0.05	-0.05	-0.05
$\partial G^{dB}_{F2} / \partial T^{FE}_{phys}$ (*dB/K*)	-0.05	-0.05	-0.05	-0.05
$\partial T_{nF1} / \partial T^{FE}_{phys}$ (*K/K*)	0.08	0.08	0.08	0.08

$\partial T_{nF2} / \partial T^{FE}_{phys}$ (K/K)	0.08	0.08	0.08	0.08
Gain Calibration Factor (V/K)	0.0043	0.00493	0.00433	0.004355

Table -3: *Default input parameters for RCA_THF analysis*

Calculating the theoretical and the measured transfer functions with RaNA, we obtain:

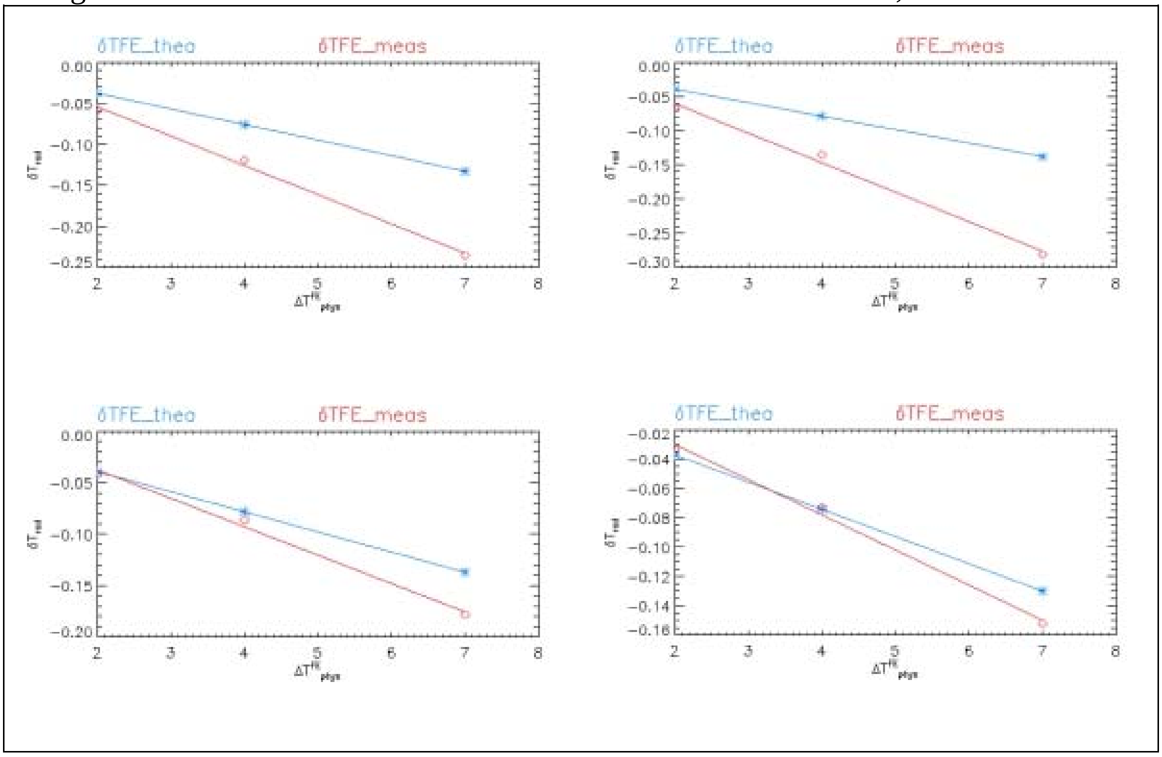


Figure -11: *RCA_THF theoretical (blue) Vs measured (red) transfer function*

Table -4: *RCA_THF Analysis Result based on default parameters*

	Channel A	Channel B	Channel C	Channel D
$f^{front-end}_{therm}$ (K/K) **theoretical**	-0.018952	-0.019686	-0.019582	-0.018569
$f^{front-end}_{therm}$ (K/K) **measured**	-0.035634	-0.043128	-0.027621	-0.023977

The complete RaNA output:

```
FEM susceptibility
INPUT
Frequency (GHz) =         44
Receiver:   LFI
Channel :    A
Load correct :    Yes
r =          1.0448612
Model:   FM
Gain calibration factor (V/K) =   value of RaNA_View
LfeedOMT_dB =         0.100000
L4K_dB =        0.100000
GF1_dB =              35
GF2_dB =              35
TnF1_K =              20
TnF2_K =              20
dGF1_dB_dTFEphys_K =       -0.0500000
dGF2_dB_dTFEphys_K =       -0.0500000
dTn1_dTFEphys_K =       0.0800000
```

```
FEM susceptibility
INPUT
Frequency (GHz) =         44
Receiver:   LFI
Channel :    B
Load correct :    Yes
r =          1.0414686
Model:   FM
Gain calibration factor (V/K) =   value of RaNA_View
LfeedOMT_dB =         0.100000
L4K_dB =        0.100000
GF1_dB =              35
GF2_dB =              35
TnF1_K =              20
TnF2_K =              20
dGF1_dB_dTFEphys_K =       -0.0500000
dGF2_dB_dTFEphys_K =       -0.0500000
dTn1_dTFEphys_K =       0.0800000
```

```
dTn2_dTFEphys_K =        0.0800000

There are              4   time windows
    tmin    tmax
         48.00         329.00
        520.00        1482.00
       1647.00        2454.00
       2649.00        3291.00

Sky Sensor =   SKY_TEMP
Ref Sensor =   REF_TEMP
FEM Sensor =   FEM_TEMP

   SKY_TEMP   REF_TEMP   FEM_TEMP
       10.50000000        7.99991846        19.99995232
       10.49999905        7.99995136        22.00032234
       10.50000000        7.99995899        24.00051689
       10.50000000        7.99993324        27.00074768

Radiometer outputs (K)
    Tsky    Tref
         37.994215         36.362931
         38.243971         36.657825
         38.504979         36.965684
         38.877864         37.433767

    Tsky-r*Tref
      -0.058368730
       -0.11902964
       -0.23522686

OUTPUT
  ftheo (K/K)    fmeas (K/K)
    -0.018952     -0.035634
```

```
dTn2_dTFEphys_K =        0.0800000

There are              4   time windows
    tmin    tmax
         48.00         329.00
        520.00        1482.00
       1647.00        2454.00
       2649.00        3291.00

Sky Sensor =   SKY_TEMP
Ref Sensor =   REF_TEMP
FEM Sensor =   FEM_TEMP

   SKY_TEMP   REF_TEMP   FEM_TEMP
       10.50000000        7.99991846        19.99995232
       10.49999905        7.99995136        22.00032234
       10.50000000        7.99995899        24.00051689
       10.50000000        7.99993324        27.00074768

Radiometer outputs (K)
    Tsky    Tref
         36.930894         35.460401
         37.179574         35.763872
         37.434367         36.073846
         37.795469         36.560129

    Tsky-r*Tref
      -0.067375315
       -0.13540998
       -0.28075658

OUTPUT
  ftheo (K/K)    fmeas (K/K)
    -0.019686     -0.043128
```

```
FEM susceptibility
INPUT
Frequency (GHz) =         44
Receiver:    LFI
Channel :      C
Load correct :     Yes
r =              1.0419499
Model:    FM
Gain calibration factor (V/K) =    value of RaNA_View
LfeedOMT_dB =           0.100000
L4K_dB =          0.100000
GF1_dB =                 35
GF2_dB =                 35
TnF1_K =                 20
TnF2_K =                 20
dGF1_dB_dTFEphys_K =       -0.0500000
dGF2_dB_dTFEphys_K =       -0.0500000
dTn1_dTFEphys_K =        0.0800000
dTn2_dTFEphys_K =        0.0800000

There are              4   time windows
    tmin    tmax
         48.00         329.00
        520.00        1482.00
       1647.00        2454.00
       2649.00        3291.00

Sky Sensor =   SKY_TEMP
Ref Sensor =   REF_TEMP
FEM Sensor =   FEM_TEMP

   SKY_TEMP   REF_TEMP   FEM_TEMP
       10.50000000        7.99991846        19.99995232
       10.49999905        7.99995136        22.00032234
       10.50000000        7.99995899        24.00051689
       10.50000000        7.99993324        27.00074768

Radiometer outputs (K)
    Tsky    Tref
         40.303937         38.681263
         40.486900         38.896909
         40.644907         39.091051
         40.923840         39.447500

    Tsky-r*Tref
      -0.041729511
      -0.086008569
       -0.17847746

OUTPUT
  ftheo (K/K)    fmeas (K/K)
    -0.019582     -0.027621
```

```
FEM susceptibility
INPUT
Frequency (GHz) =         44
Receiver:    LFI
Channel :      D
Load correct :     Yes
r =              1.0466342
Model:    FM
Gain calibration factor (V/K) =    value of RaNA_View
LfeedOMT_dB =           0.100000
L4K_dB =          0.100000
GF1_dB =                 35
GF2_dB =                 35
TnF1_K =                 20
TnF2_K =                 20
dGF1_dB_dTFEphys_K =       -0.0500000
dGF2_dB_dTFEphys_K =       -0.0500000
dTn1_dTFEphys_K =        0.0800000
dTn2_dTFEphys_K =        0.0800000

There are              4   time windows
    tmin    tmax
         48.00         329.00
        520.00        1482.00
       1647.00        2454.00
       2649.00        3291.00

Sky Sensor =   SKY_TEMP
Ref Sensor =   REF_TEMP
FEM Sensor =   FEM_TEMP

   SKY_TEMP   REF_TEMP   FEM_TEMP
       10.50000000        7.99991846        19.99995232
       10.49999905        7.99995136        22.00032234
       10.50000000        7.99995899        24.00051689
       10.50000000        7.99993324        27.00074768

Radiometer outputs (K)
    Tsky    Tref
         41.179062         39.344274
         41.367648         39.556258
         41.530721         39.749732
         41.811906         40.094254

    Tsky-r*Tref
      -0.033283312
      -0.072706355
       -0.15210943

OUTPUT
  ftheo (K/K)    fmeas (K/K)
    -0.018569     -0.023977
```

To improve the results obtained with the default parameters, I am going to change any of them. In particular, I change the $\partial G^{dB}_{FE}/\partial T^{FE}_{phys}$ and $\partial T_{nFE}/\partial T^{FE}_{phys}$. The best values will be:

Table -5: *Optimized parameters of RCA_THF test*

	Ch. A	Ch. B	Ch. C	Ch. D
$\partial G^{dB}_{F1}/\partial T^{FE}_{phys}$ (dB/K)	-0.1	-0.12	-0.075	-0.062
$\partial G^{dB}_{F2}/\partial T^{FE}_{phys}$ (dB/K)	-0.1	-0.12	-0.075	-0.062
$\partial T_{nF1}/\partial T^{FE}_{phys}$ (K/K)	0.13	0.13	0.09	0.125
$\partial T_{nF2}/\partial T^{FE}_{phys}$ (K/K)	0.13	0.13	0.09	0.125

and calculating the transfer functions, the new results:

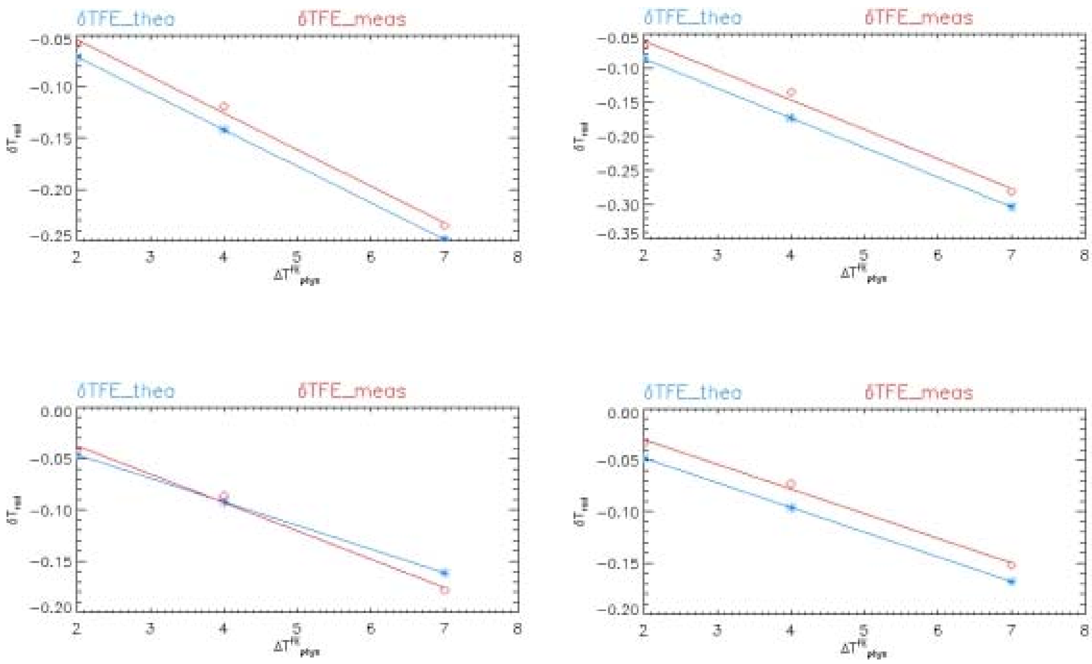


Figure -12: *RCA_THF theoretical Vs measured transfer function after optimisation of the parameters.*

Table -6: *RCA_THF Optimal transfer function Vs. theoretical*

	Channel A	Channel B	Channel C	Channel D
$f^{front-end}_{therm}$ (K/K) theoretical	-0.035483	-0.043264	-0.027597	-0.023996
$f^{front-end}_{therm}$ (K/K) measured	-0.035634	-0.043128	-0.027621	-0.023977

The complete RaNA output:

```
FEM susceptibility
INPUT
Frequency (GHz) =         44
Receiver:   LFI
Channel :    A
Load correct :    Yes
r =             1.0448612
Model:   FM
Gain calibration factor (V/K) =   value of RaNA_View
LfeedOMT_dB =          0.100000
L4K_dB =          0.100000
GF1_dB =               35
GF2_dB =               35
TnF1_K =               20
TnF2_K =               20
dGF1_dB_dTFEphys_K =         -0.100000
dGF2_dB_dTFEphys_K =         -0.100000
dTn1_dTFEphys_K =         0.130000
dTn2_dTFEphys_K =         0.130000

There are                4   time windows
    tmin   tmax
         48.00        329.00
        520.00       1482.00
       1647.00       2454.00
       2649.00       3291.00

Sky Sensor =   SKY_TEMP
Ref Sensor =   REF_TEMP
FEM Sensor =   FEM_TEMP

   SKY_TEMP  REF_TEMP  FEM_TEMP
       10.50000000        7.99991846        19.99995232
       10.49999905        7.99995136        22.00032234
       10.50000000        7.99995899        24.00051689
       10.50000000        7.99993324        27.00074768

Radiometer outputs (K)
    Tsky   Tref
         37.994215         36.362931
         38.243971         36.657825
         38.504979         36.965684
         38.877864         37.433767

    Tsky-r*Tref
      -0.058368730
       -0.11902964
       -0.23522686

OUTPUT
  ftheo (K/K)    fmeas (K/K)
    -0.035483     -0.035634
```

```
FEM susceptibility
INPUT
Frequency (GHz) =         44
Receiver:   LFI
Channel :    B
Load correct :    Yes
r =             1.0414686
Model:   FM
Gain calibration factor (V/K) =   value of RaNA_View
LfeedOMT_dB =          0.100000
L4K_dB =          0.100000
GF1_dB =               35
GF2_dB =               35
TnF1_K =               20
TnF2_K =               20
dGF1_dB_dTFEphys_K =         -0.120000
dGF2_dB_dTFEphys_K =         -0.120000
dTn1_dTFEphys_K =         0.130000
dTn2_dTFEphys_K =         0.130000

There are                4   time windows
    tmin   tmax
         48.00        329.00
        520.00       1482.00
       1647.00       2454.00
       2649.00       3291.00

Sky Sensor =   SKY_TEMP
Ref Sensor =   REF_TEMP
FEM Sensor =   FEM_TEMP

   SKY_TEMP  REF_TEMP  FEM_TEMP
       10.50000000        7.99991846        19.99995232
       10.49999905        7.99995136        22.00032234
       10.50000000        7.99995899        24.00051689
       10.50000000        7.99993324        27.00074768

Radiometer outputs (K)
    Tsky   Tref
         36.930894         35.460401
         37.179574         35.763872
         37.434367         36.073846
         37.795469         36.560129

    Tsky-r*Tref
      -0.067375315
       -0.13540998
       -0.28075658

OUTPUT
  ftheo (K/K)    fmeas (K/K)
    -0.043264     -0.043128
```

```
FEM susceptibility
INPUT
Frequency (GHz) =         44
Receiver:   LFI
Channel :    C
Load correct :    Yes
r =             1.0419499
Model:   FM
Gain calibration factor (V/K) =   value of RaNA_View
LfeedOMT_dB =          0.100000
L4K_dB =          0.100000
GF1_dB =               35
GF2_dB =               35
TnF1_K =               20
TnF2_K =               20
dGF1_dB_dTFEphys_K =        -0.0750000
dGF2_dB_dTFEphys_K =        -0.0750000
dTn1_dTFEphys_K =        0.0900000
dTn2_dTFEphys_K =        0.0900000

There are                4   time windows
    tmin   tmax
         48.00        329.00
        520.00       1482.00
       1647.00       2454.00
       2649.00       3291.00

Sky Sensor =   SKY_TEMP
Ref Sensor =   REF_TEMP
FEM Sensor =   FEM_TEMP

   SKY_TEMP  REF_TEMP  FEM_TEMP
       10.50000000        7.99991846        19.99995232
       10.49999905        7.99995136        22.00032234
```

```
FEM susceptibility
INPUT
Frequency (GHz) =         44
Receiver:   LFI
Channel :    D
Load correct :    Yes
r =             1.0466342
Model:   FM
Gain calibration factor (V/K) =   value of RaNA_View
LfeedOMT_dB =          0.100000
L4K_dB =          0.100000
GF1_dB =               35
GF2_dB =               35
TnF1_K =               20
TnF2_K =               20
dGF1_dB_dTFEphys_K =        -0.0620000
dGF2_dB_dTFEphys_K =        -0.0620000
dTn1_dTFEphys_K =         0.125000
dTn2_dTFEphys_K =         0.125000

There are                4   time windows
    tmin   tmax
         48.00        329.00
        520.00       1482.00
       1647.00       2454.00
       2649.00       3291.00

Sky Sensor =   SKY_TEMP
Ref Sensor =   REF_TEMP
FEM Sensor =   FEM_TEMP

   SKY_TEMP  REF_TEMP  FEM_TEMP
       10.50000000        7.99991846        19.99995232
       10.49999905        7.99995136        22.00032234
```

<pre>   10.50000000   7.99995899   24.00051689
      10.50000000   7.99993324   27.00074768
 	
Radiometer outputs (K)
    Tsky   Tref
         40.303937   38.681263
         40.486900   38.896909
         40.644907   39.091051
         40.923840   39.447500
 	
    Tsky-r*Tref
      -0.041729511
      -0.086008569
       -0.17847746
 	
OUTPUT
  ftheo (K/K)   fmeas (K/K)
    -0.027597   -0.027621</pre>
	<pre> 10.50000000 7.99995899 24.00051689
	      10.50000000 7.99993324 27.00074768
	
	Radiometer outputs (K)
	    Tsky Tref
	         41.179062 39.344274
	         41.367648 39.556258
	         41.530721 39.749732
	         41.811906 40.094254
	
	    Tsky-r*Tref
	      -0.033283312
	      -0.072706355
	       -0.15210943
	
	OUTPUT
	  ftheo (K/K) fmeas (K/K)
	    -0.023996 -0.023977</pre>

Analysis using the SMON_TMP probe as sky load temperature:
The default parameters for the four channels are:

Table -7: *Default input parameters for RCA_THF analysis*

	Ch. A	Ch. B	Ch. C	Ch. D
Freq. (*GHz*)	30			
$L_{feed-OMT}$ (*dB*)	0.1			
L_{4k} (*dB*)	0.1			
r	1.044862	1.0414686	1.0419499	1.0466342
T_{sky} (*K*)	10.849			
T_{ref} (*K*)	7.9999			
G^{dB}_{F1} **(*dB*)**	35			
G^{dB}_{F2} **(*dB*)**	35			
T_{nF1} (*K*)	20	20	20	20
T_{nF2} (*K*)	20	20	20	20
$\partial G^{dB}_{F1} / \partial T^{FE}_{phys}$ **(*dB/K*)**	-0.05	-0.05	-0.05	-0.05
$\partial G^{dB}_{F2} / \partial T^{FE}_{phys}$ **(*dB/K*)**	-0.05	-0.05	-0.05	-0.05
$\partial T_{nF1} / \partial T^{FE}_{phys}$ **(*K/K*)**	0.08	0.08	0.08	0.08
$\partial T_{nF2} / \partial T^{FE}_{phys}$ **(*K/K*)**	0.08	0.08	0.08	0.08
Gain Calibration Factor (*V/K*)	0.0043	0.00493	0.00433	0.004355

Calculating the theoretical and the measured transfer functions with RaNA, we obtain:

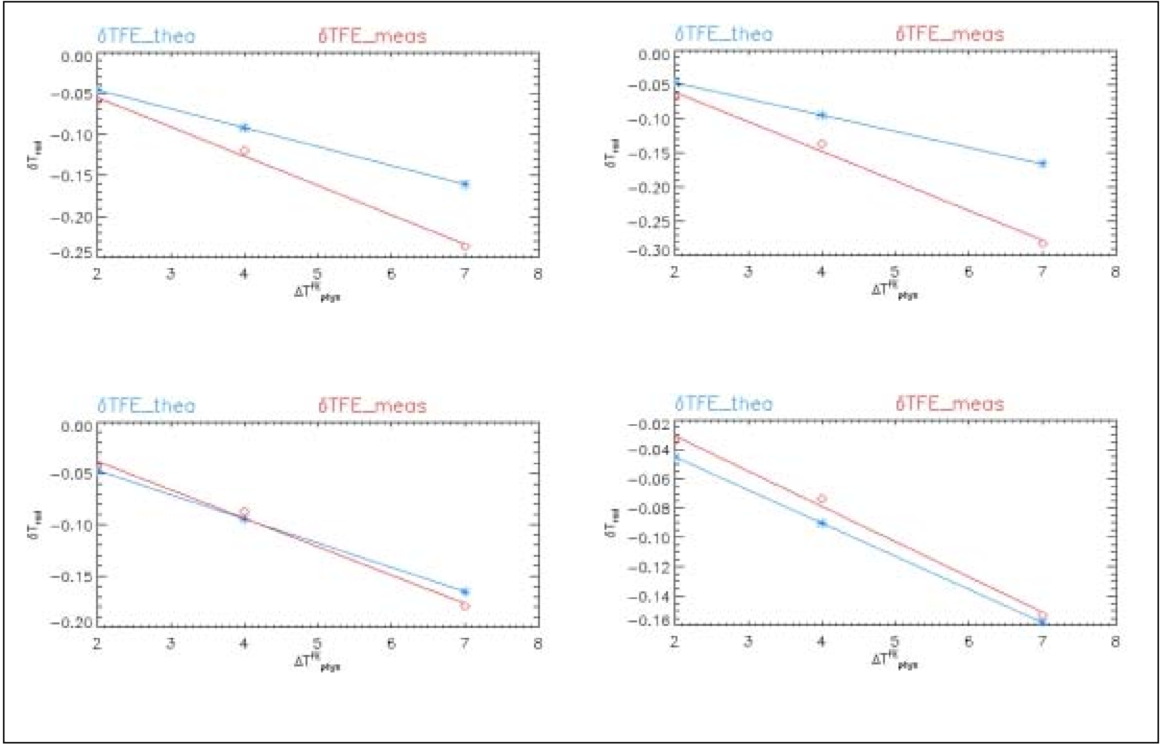


Figure -13: *RCA_THF theoretical (blue) Vs measured (red) transfer function*

Table -8: *RCA_THF Analysis Result based on default parameters*

	Channel A	Channel B	Channel C	Channel D
$f_{therm}^{front-end}$ **(K/K) theoretical**	-0.022958	-0.023692	-0.023588	-0.022574
$f_{therm}^{front-end}$ **(K/K) measured**	-0.035696	-0.043190	-0.027684	-0.024039

The complete RaNA output:

```
FEM susceptibility
INPUT
Frequency (GHz) =          44
Receiver:   LFI
Channel :    A
Load correct :     Yes
r =          1.0448612
Model:   FM
Gain calibration factor (V/K) =    value of RaNA_View
LfeedOMT_dB =         0.100000
L4K_dB =         0.100000
GF1_dB =              35
GF2_dB =              35
TnF1_K =              20
TnF2_K =              20
dGF1_dB_dTFEphys_K =       -0.0500000
dGF2_dB_dTFEphys_K =       -0.0500000
dTn1_dTFEphys_K =        0.0800000
dTn2_dTFEphys_K =        0.0800000

There are              4    time windows
    tmin    tmax
         48.00        329.00
        520.00       1482.00
       1647.00       2454.00
       2649.00       3291.00
```

```
FEM susceptibility
INPUT
Frequency (GHz) =          44
Receiver:   LFI
Channel :    B
Load correct :     Yes
r =          1.0414686
Model:   FM
Gain calibration factor (V/K) =    value of RaNA_View
LfeedOMT_dB =         0.100000
L4K_dB =         0.100000
GF1_dB =              35
GF2_dB =              35
TnF1_K =              20
TnF2_K =              20
dGF1_dB_dTFEphys_K =       -0.0500000
dGF2_dB_dTFEphys_K =       -0.0500000
dTn1_dTFEphys_K =        0.0800000
dTn2_dTFEphys_K =        0.0800000

There are              4    time windows
    tmin    tmax
         48.00        329.00
        520.00       1482.00
       1647.00       2454.00
       2649.00       3291.00
```

```
Sky Sensor =   SMON_TMP
Ref Sensor =   REF_TEMP
FEM Sensor =   FEM_TEMP

   SMON_TMP  REF_TEMP  FEM_TEMP
       10.84904289        7.99991846       19.99995232
       10.84972858        7.99995136       22.00032234
       10.85003853        7.99995899       24.00051689
       10.85006332        7.99993324       27.00074768

Radiometer outputs (K)
    Tsky   Tref
         37.994215         36.362931
         38.243284         36.657825
         38.503984         36.965684
         38.876843         37.433767

    Tsky-r*Tref
      -0.059055376
       -0.12002528
       -0.23624729

OUTPUT
  ftheo (K/K)   fmeas (K/K)
    -0.022958    -0.035696
```

```
Sky Sensor =   SMON_TMP
Ref Sensor =   REF_TEMP
FEM Sensor =   FEM_TEMP

   SMON_TMP  REF_TEMP  FEM_TEMP
       10.84904289        7.99991846       19.99995232
       10.84972858        7.99995136       22.00032234
       10.85003853        7.99995899       24.00051689
       10.85006332        7.99993324       27.00074768

Radiometer outputs (K)
    Tsky   Tref
         36.930894         35.460401
         37.178887         35.763872
         37.433371         36.073846
         37.794448         36.560129

    Tsky-r*Tref
      -0.068061961
       -0.13640562
       -0.28177701

OUTPUT
  ftheo (K/K)   fmeas (K/K)
    -0.023692    -0.043190
```

```
FEM susceptibility
INPUT
Frequency (GHz) =         44
Receiver:   LFI
Channel :    C
Load correct :    Yes
r =           1.0419499
Model:   FM
Gain calibration factor (V/K) =   value of RaNA_View
LfeedOMT_dB =         0.100000
L4K_dB =         0.100000
GF1_dB =              35
GF2_dB =              35
TnF1_K =              20
TnF2_K =              20
dGF1_dB_dTFEphys_K =       -0.0500000
dGF2_dB_dTFEphys_K =       -0.0500000
dTn1_dTFEphys_K =        0.0800000
dTn2_dTFEphys_K =        0.0800000

There are             4   time windows
    tmin    tmax
         48.00        329.00
        520.00       1482.00
       1647.00       2454.00
       2649.00       3291.00

Sky Sensor =   SMON_TMP
Ref Sensor =   REF_TEMP
FEM Sensor =   FEM_TEMP

   SMON_TMP  REF_TEMP  FEM_TEMP
       10.84904289        7.99991846       19.99995232
       10.84972858        7.99995136       22.00032234
       10.85003853        7.99995899       24.00051689
       10.85006332        7.99993324       27.00074768

Radiometer outputs (K)
    Tsky   Tref
         40.303937         38.681263
         40.486213         38.896909
         40.643911         39.091051
         40.922819         39.447500

    Tsky-r*Tref
      -0.042416157
      -0.087004205
       -0.17949789

OUTPUT
  ftheo (K/K)   fmeas (K/K)
    -0.023588    -0.027684
```

```
FEM susceptibility
INPUT
Frequency (GHz) =         44
Receiver:   LFI
Channel :    D
Load correct :    Yes
r =           1.0466342
Model:   FM
Gain calibration factor (V/K) =   value of RaNA_View
LfeedOMT_dB =         0.100000
L4K_dB =         0.100000
GF1_dB =              35
GF2_dB =              35
TnF1_K =              20
TnF2_K =              20
dGF1_dB_dTFEphys_K =       -0.0500000
dGF2_dB_dTFEphys_K =       -0.0500000
dTn1_dTFEphys_K =        0.0800000
dTn2_dTFEphys_K =        0.0800000

There are             4   time windows
    tmin    tmax
         48.00        329.00
        520.00       1482.00
       1647.00       2454.00
       2649.00       3291.00

Sky Sensor =   SMON_TMP
Ref Sensor =   REF_TEMP
FEM Sensor =   FEM_TEMP

   SMON_TMP  REF_TEMP  FEM_TEMP
       10.84904289        7.99991846       19.99995232
       10.84972858        7.99995136       22.00032234
       10.85003853        7.99995899       24.00051689
       10.85006332        7.99993324       27.00074768

Radiometer outputs (K)
    Tsky   Tref
         41.179062         39.344274
         41.366961         39.556258
         41.529726         39.749732
         41.810886         40.094254

    Tsky-r*Tref
      -0.033969958
      -0.073701991
       -0.15312986

OUTPUT
  ftheo (K/K)   fmeas (K/K)
    -0.022574    -0.024039
```

To improve the results obtained with the default parameters, I am going to change any of them. In particular, I change the $\partial G_{FE}^{dB} / \partial T_{phys}^{FE}$ and $\partial T_{nFE} / \partial T_{phys}^{FE}$. The best values will be:

Table -9: *Optimized parameters of RCA_THF test*

	Ch. A	Ch. B	Ch. C	Ch. D
$\partial G_{F1}^{dB} / \partial T_{phys}^{FE}$ (dB/K)	-0.085	-0.095	-0.06	-0.052
$\partial G_{F2}^{dB} / \partial T_{phys}^{FE}$ (dB/K)	-0.085	-0.095	-0.06	-0.052
$\partial T_{nF1} / \partial T_{phys}^{FE}$ (K/K)	0.080	0.13	0.09	0.096
$\partial T_{nF2} / \partial T_{phys}^{FE}$ (K/K)	0.080	0.13	0.09	0.096

and calculating the transfer functions, the new results:

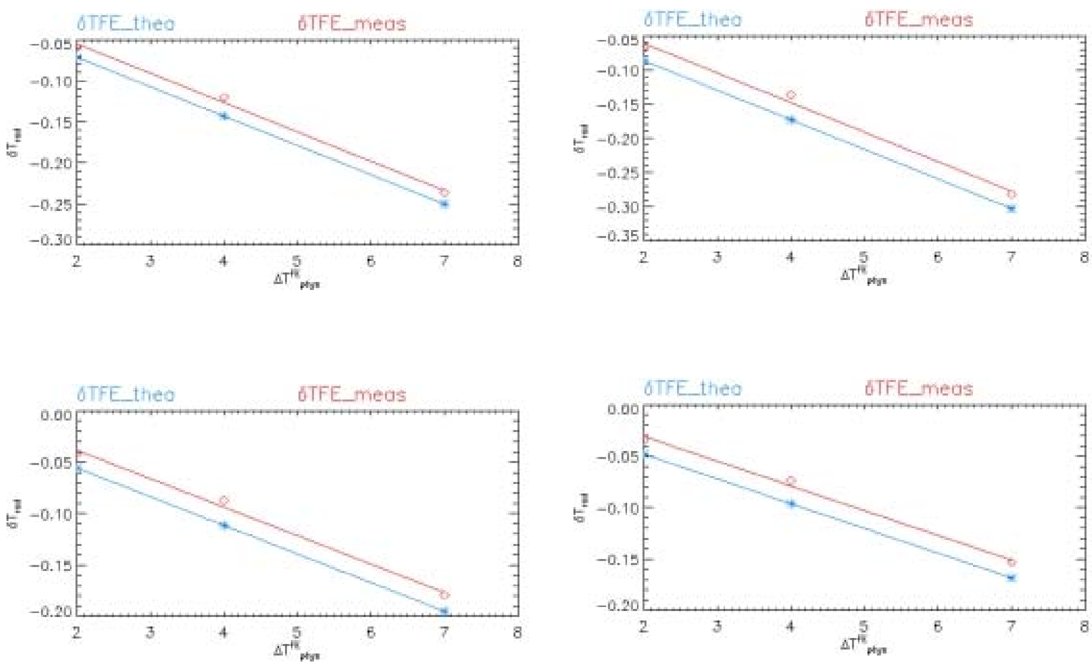


Figure -14: *RCA_THF theoretical Vs measured transfer function after optimization of the parameters.*

Table -10: *RCA_THF Optimal transfer function Vs. theoretical*

	Channel A	Channel B	Channel C	Channel D
$f_{therm}^{front-end}$ (K/K) theoretical	-0.035726	-0.043211	-0.027852	-0.024045
$f_{therm}^{front-end}$ (K/K) measured	-0.035696	-0.04319	-0.027684	-0.024039

The complete RaNA output:

```
FEM susceptibility
INPUT
Frequency (GHz) =         44
Receiver:   LFI
Channel :    A
Load correct :    Yes
r =            1.0448612
Model:   FM
Gain calibration factor (V/K) =   value of RaNA_View
LfeedOMT_dB =          0.100000
L4K_dB =         0.100000
GF1_dB =               35
GF2_dB =               35
TnF1_K =               20
TnF2_K =               20
dGF1_dB_dTFEphys_K =        -0.0850000
dGF2_dB_dTFEphys_K =        -0.0850000
dTn1_dTFEphys_K =         0.0800000
dTn2_dTFEphys_K =         0.0800000

There are              4   time windows
    tmin    tmax
         48.00        329.00
        520.00       1482.00
       1647.00       2454.00
       2649.00       3291.00

Sky Sensor =    SMON_TMP
Ref Sensor =    REF_TEMP
FEM Sensor =    FEM_TEMP

   SMON_TMP   REF_TEMP   FEM_TEMP
       10.84904289       7.99991846       19.99995232
       10.84972858       7.99995136       22.00032234
       10.85003853       7.99995899       24.00051689
       10.85006332       7.99993324       27.00074768

Radiometer outputs (K)
    Tsky    Tref
         37.994215         36.362931
         38.243284         36.657825
         38.503984         36.965684
         38.876843         37.433767

    Tsky-r*Tref
      -0.059055376
       -0.12002528
       -0.23624729

OUTPUT
  ftheo (K/K)    fmeas (K/K)
    -0.035726    -0.035696
```

```
FEM susceptibility
INPUT
Frequency (GHz) =         44
Receiver:   LFI
Channel :    B
Load correct :    Yes
r =            1.0414686
Model:   FM
Gain calibration factor (V/K) =   value of RaNA_View
LfeedOMT_dB =          0.100000
L4K_dB =         0.100000
GF1_dB =               35
GF2_dB =               35
TnF1_K =               20
TnF2_K =               20
dGF1_dB_dTFEphys_K =        -0.0950000
dGF2_dB_dTFEphys_K =        -0.0950000
dTn1_dTFEphys_K =         0.130000
dTn2_dTFEphys_K =         0.130000

There are              4   time windows
    tmin    tmax
         48.00        329.00
        520.00       1482.00
       1647.00       2454.00
       2649.00       3291.00

Sky Sensor =    SMON_TMP
Ref Sensor =    REF_TEMP
FEM Sensor =    FEM_TEMP

   SMON_TMP   REF_TEMP   FEM_TEMP
       10.84904289       7.99991846       19.99995232
       10.84972858       7.99995136       22.00032234
       10.85003853       7.99995899       24.00051689
       10.85006332       7.99993324       27.00074768

Radiometer outputs (K)
    Tsky    Tref
         36.930894         35.460401
         37.178887         35.763872
         37.433371         36.073846
         37.794448         36.560129

    Tsky-r*Tref
      -0.068061961
       -0.13640562
       -0.28177701

OUTPUT
  ftheo (K/K)    fmeas (K/K)
    -0.043211    -0.043190
```

```
FEM susceptibility
INPUT
Frequency (GHz) =         44
Receiver:   LFI
Channel :    C
Load correct :    Yes
r =            1.0419499
Model:   FM
Gain calibration factor (V/K) =   value of RaNA_View
LfeedOMT_dB =          0.100000
L4K_dB =         0.100000
GF1_dB =               35
GF2_dB =               35
TnF1_K =               20
TnF2_K =               20
dGF1_dB_dTFEphys_K =        -0.0600000
dGF2_dB_dTFEphys_K =        -0.0600000
dTn1_dTFEphys_K =         0.0900000
dTn2_dTFEphys_K =         0.0900000

There are              4   time windows
    tmin    tmax
         48.00        329.00
        520.00       1482.00
       1647.00       2454.00
       2649.00       3291.00

Sky Sensor =    SMON_TMP
Ref Sensor =    REF_TEMP
FEM Sensor =    FEM_TEMP

   SMON_TMP   REF_TEMP   FEM_TEMP
       10.84904289       7.99991846       19.99995232
       10.84972858       7.99995136       22.00032234
       10.85003853       7.99995899       24.00051689
       10.85006332       7.99993324       27.00074768
```

```
FEM susceptibility
INPUT
Frequency (GHz) =         44
Receiver:   LFI
Channel :    D
Load correct :    Yes
r =            1.0466342
Model:   FM
Gain calibration factor (V/K) =   value of RaNA_View
LfeedOMT_dB =          0.100000
L4K_dB =         0.100000
GF1_dB =               35
GF2_dB =               35
TnF1_K =               20
TnF2_K =               20
dGF1_dB_dTFEphys_K =        -0.0520000
dGF2_dB_dTFEphys_K =        -0.0520000
dTn1_dTFEphys_K =        0.0960000
dTn2_dTFEphys_K =        0.0960000

There are              4   time windows
    tmin    tmax
         48.00        329.00
        520.00       1482.00
       1647.00       2454.00
       2649.00       3291.00

Sky Sensor =    SMON_TMP
Ref Sensor =    REF_TEMP
FEM Sensor =    FEM_TEMP

   SMON_TMP   REF_TEMP   FEM_TEMP
       10.84904289       7.99991846       19.99995232
       10.84972858       7.99995136       22.00032234
       10.85003853       7.99995899       24.00051689
       10.85006332       7.99993324       27.00074768
```

Radiometer outputs (K) Tsky Tref 40.303937 38.681263 40.486213 38.896909 40.643911 39.091051 40.922819 39.447500 Tsky-r*Tref -0.042416157 -0.087004205 -0.17949789 OUTPUT ftheo (K/K) fmeas (K/K) -0.027852 -0.027684	Radiometer outputs (K) Tsky Tref 41.179062 39.344274 41.366961 39.556258 41.529726 39.749732 41.810886 40.094254 Tsky-r*Tref -0.033969958 -0.073701991 -0.15312986 OUTPUT ftheo (K/K) fmeas (K/K) -0.024045 -0.024039

RCA25_SPR 1600

P.Battaglia & F.Villa

Mon May 22 11:45:20 2006

0.1 001

0.1.1 RANA_SPR_001

Data from file set: 044LFI25_RCA_FM_SPR_200605191600
Contained in directory: G:/CALIBRATION_DATA/FM/RCA25

Input Data

Frequency: 30 GHz
Trigger Detector: A
F_min: 33.00 GHz
F_max: 50.00 GHz
Step: 0.05 GHz
Threshold: 0.0250 V/s
Useful Data: 50.00 %
Calibration File: D:/LIFE/v1r0p1/RaNA/RaNA_SPR/cal_FM_44_08022006.dat

Comments

RCA_SPR Test −32dBm power input
Waveguide path:
MAIN_1: 1A2B
MAIN_2: 1A2B
SIDE_1: 3C4D
SIDE_2: 3C4D

Output Data

Table 1: Central frequency and equivalent bandwidth.

CHANNEL	CENTRAL FREQUENCY (GHz)	EQUIVALENT BANDWIDTH (GHz)
A	44.90	5.91
B	45.85	4.17
C	45.75	4.42
D	45.25	4.49

Derivative Plots

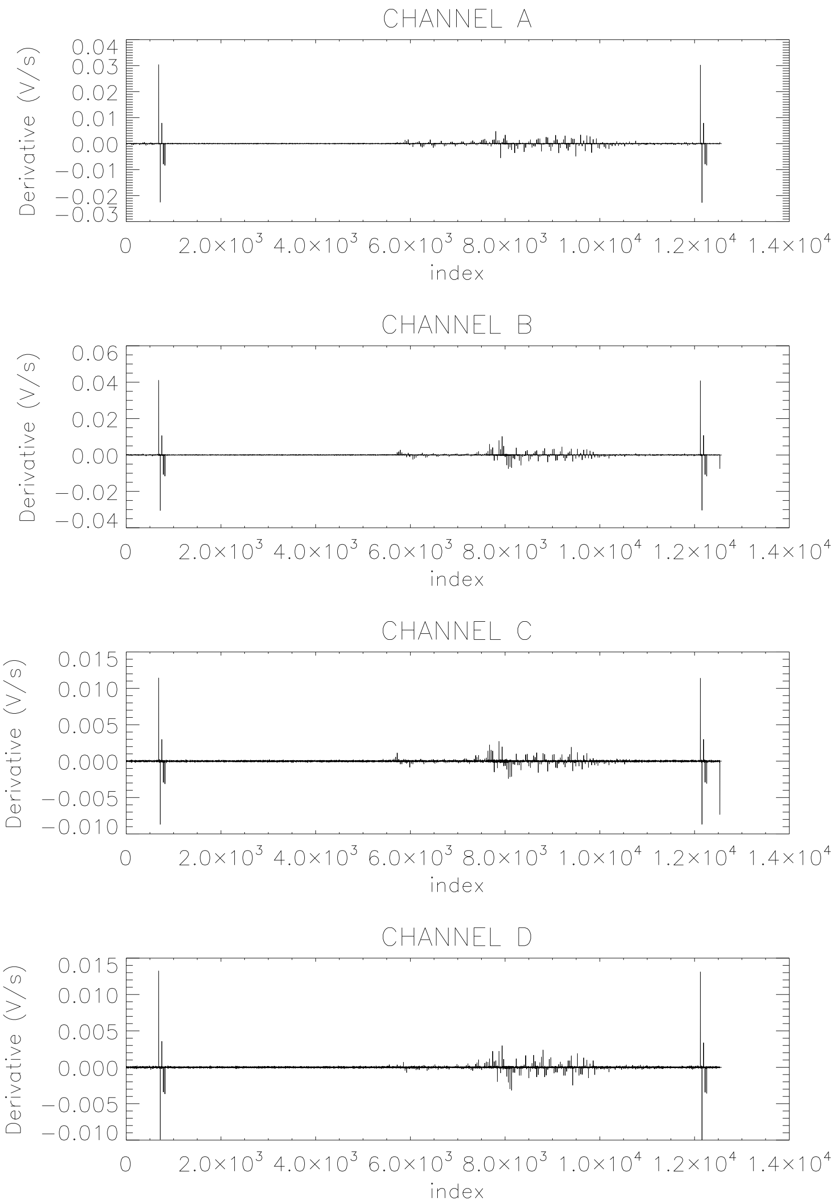


Figure 1: Data binned with a bin equal to 0.

Selected Plots

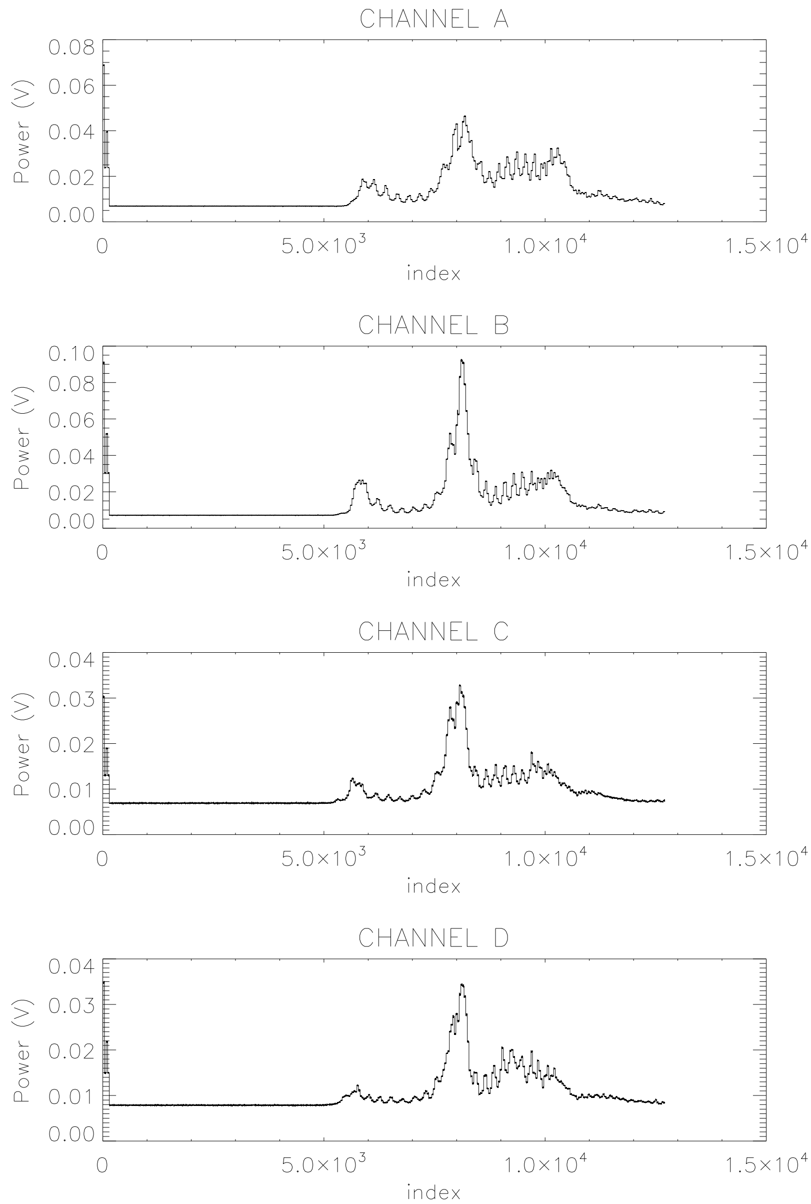


Figure 2: Data binned with a bin equal to 0.

Radiometer Spectral Response

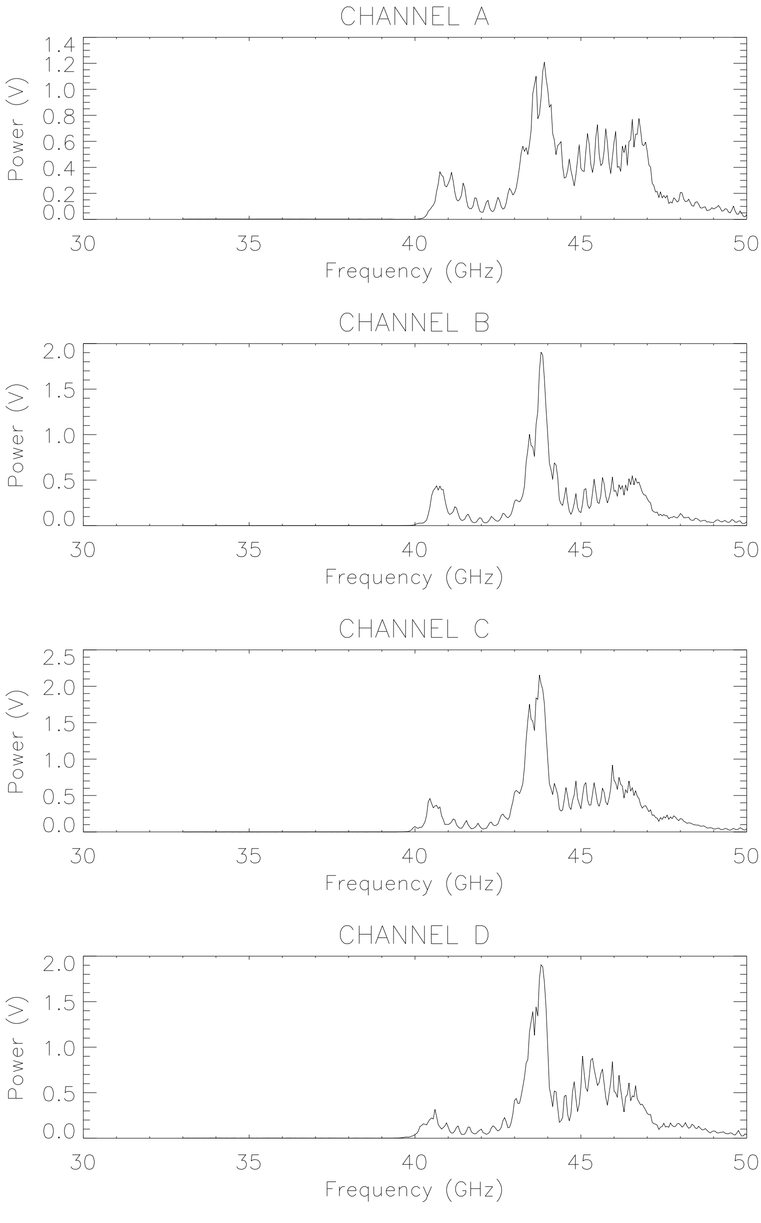


Figure 3: Calibrated data.

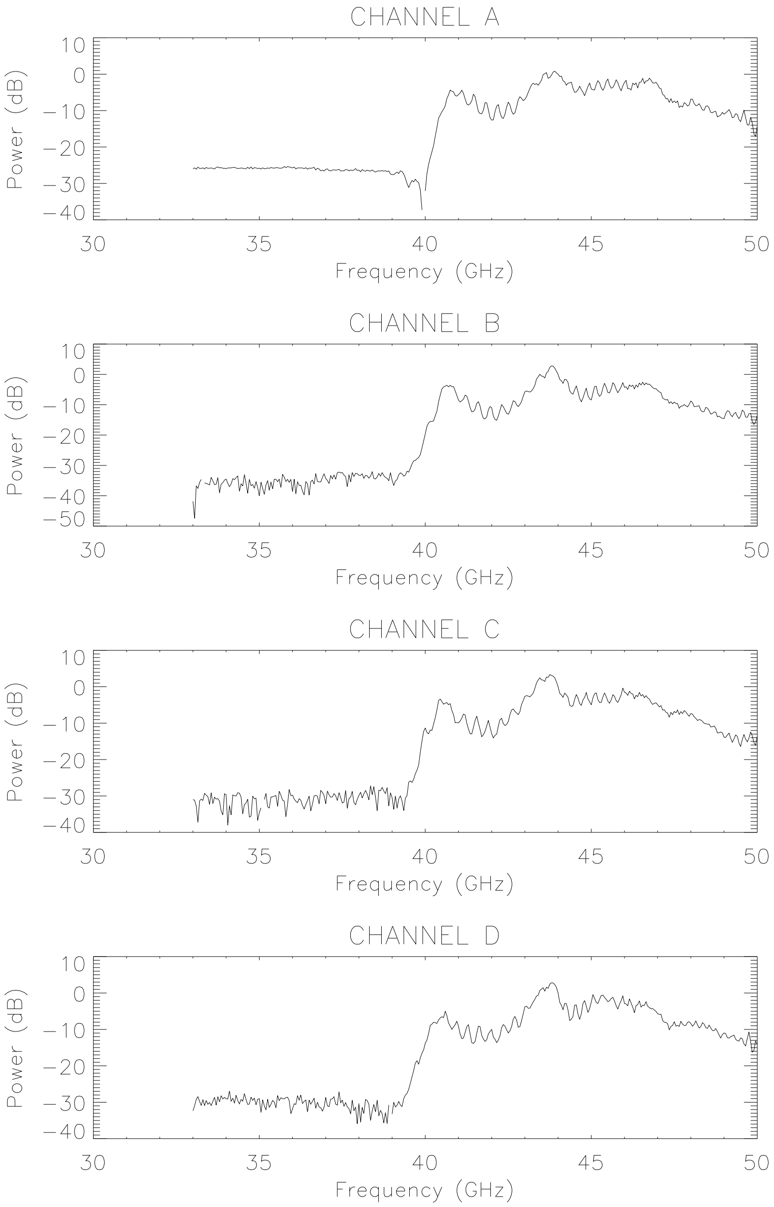


Figure 4: Calibrated data in dB.

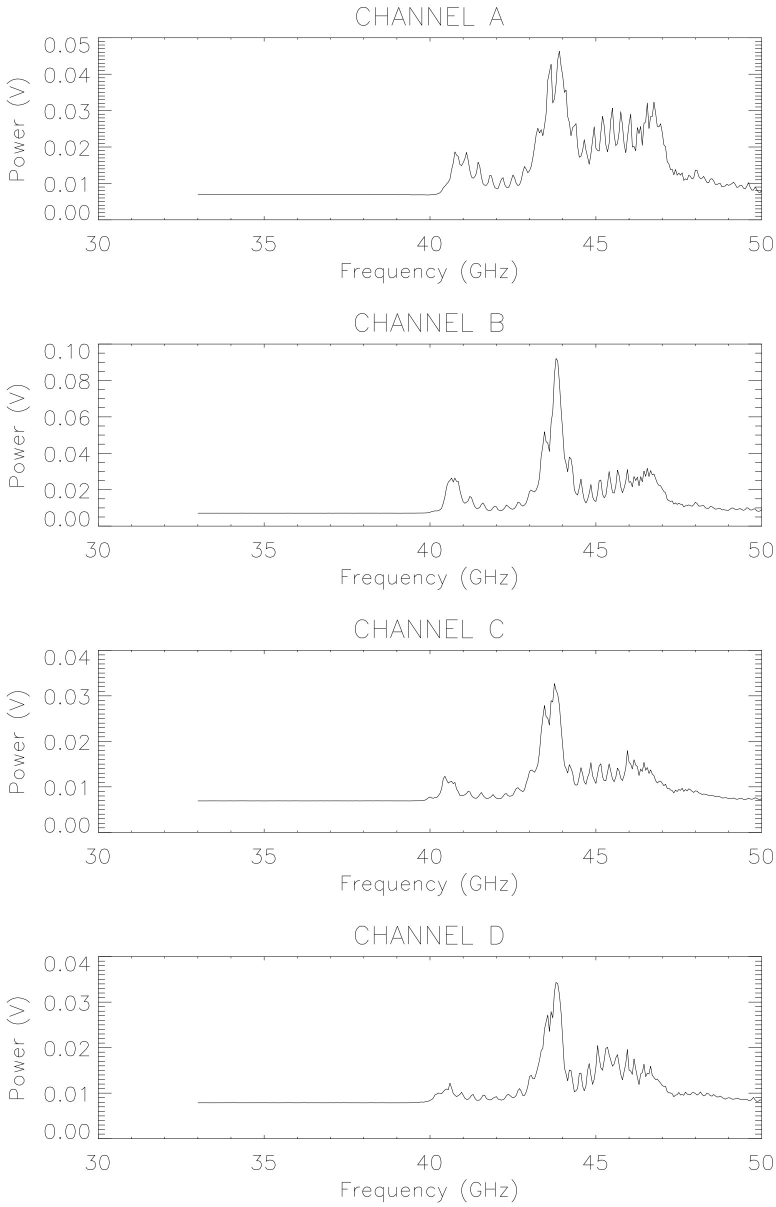


Figure 5: Uncalibrated data.

Report

RaNA

Tue May 23 10:50:15 2006

Chapter 1

/root/RaNA-Mon-May-22-18:04:20-2006/rana-view

Chapter 2

/root/RaNA-Mon-May-22-18:04:20-2006/rana-tn

Chapter 3

/root/RaNA-Mon-May-22-18:04:20-2006/rana-oft

Chapter 4

/root/RaNA-Mon-May-22-18:04:20-2006/rana-ling

4.1 rana_ling_mini_report_001

RANA_LING 001

Linearity, Isolation and Gain

Data from file set: 044LFI25_RCA_FM_LIS_200605210014
Contained in directory: /moredata

INPUT
Channel: A
Sky temperature source: RMON_TEMP
Ref temperature source: SMON_TMP
Changing voltage channel: Ref

44.0 GHz radiometer						
T_{change} [K]	σT_{change} [K]	T_{fixed} [K]	σT_{fixed} [K]	V_{change} [V]	σV_{change} [V]	V_{fixed} [V]
8.1223984	0.00042186480	10.846000	0.0000000	0.15488059	0.00025139924	0.16173711
9.7140560	0.00061591557	10.846000	0.0000000	0.16292650	0.00027299065	0.16207622
11.909731	0.00092340010	10.897795	0.0076848129	0.17381222	0.00028140687	0.16274261
14.101195	0.0012419425	11.119487	0.019805765	0.18440530	0.00029648531	0.16417021
16.293547	0.0012031965	11.403072	0.031745821	0.19465033	0.00030910269	0.16596230
18.493633	0.0013364778	11.723660	0.038061414	0.20464003	0.00031901532	0.16798282
20.687559	0.00050475716	12.080558	0.028382350	0.21438699	0.00032939626	0.17030165
22.884939	0.00048026923	12.400681	0.040943764	0.22380659	0.00034045266	0.17230963
25.079792	0.00060092931	12.725376	0.048759017	0.23301702	0.00035283556	0.17438016
27.267574	0.00061342079	13.097605	0.028281266	0.24201386	0.00035383949	0.17680002
29.463646	0.00074809330	13.389616	0.033689551	0.25068994	0.00036991355	0.17863041
31.673006	0.00066137878	13.710905	0.028031461	0.25919348	0.00037718084	0.18067170
33.856815	0.00075800251	13.960006	0.043223180	0.26745971	0.00038588630	0.18230055

RESULTS

I [dB]	σI [dB]	G [V/K]	σG [V/K]
-12.697080	-0.081696881	0.0041154162	2.0046203e-05

L	σL	T_{noise} [K]	σT_{noise} [K]
0.0021720858	0.00057663505	28.362380	0.12614464

COMMENTS

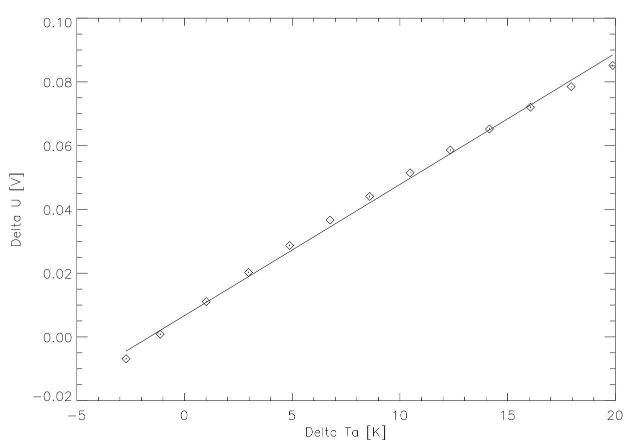


Figure 4.1: Response linearity (differenced values)

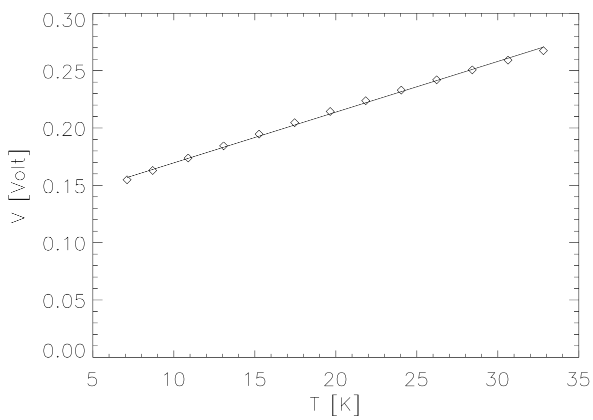


Figure 4.2: Response linearity (changing temperature vs changing voltage

4.2 rana_ling_mini_report_002

RANA_LING 002

Linearity, Isolation and Gain

Data from file set: 044LFI25_RCA_FM_LIS_200605210014
Contained in directory: /moredata

INPUT
Channel: B
Sky temperature source: RMON_TEMP
Ref temperature source: SMON_TMP
Changing voltage channel: Ref

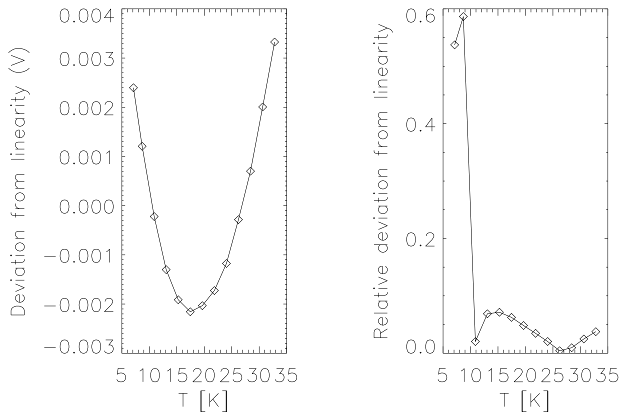


Figure 4.3: Deviation from linearity

44.0 GHz radiometer						
T_{change} [K]	σT_{change} [K]	T_{fixed} [K]	σT_{fixed} [K]	V_{change} [V]	σV_{change} [V]	V_{fixed} [V]
8.1223888	0.00041652037	10.845995	6.5475790e-05	0.17497982	0.00033857851	0.18225207
9.7140379	0.00061255164	10.846000	0.0000000	0.18403733	0.00035768341	0.18254425
11.909758	0.00093274110	10.899006	0.0067585651	0.19634658	0.00037401687	0.18322869
14.101271	0.0012380847	11.109222	0.022961389	0.20828284	0.00038801198	0.18460820
16.293615	0.0012474812	11.396014	0.035505477	0.21987413	0.00040329758	0.18658544
18.493633	0.0013338038	11.726986	0.035621252	0.23121075	0.00041729192	0.18887346
20.687563	0.00050424680	12.073358	0.030534284	0.24230281	0.00042930547	0.19136675
22.884937	0.00048135081	12.405801	0.037261333	0.25309682	0.00044158427	0.19372505
25.079782	0.00060180039	12.743038	0.037120834	0.26359456	0.00045555288	0.19607053
27.267601	0.00059679640	13.101120	0.021861119	0.27385305	0.00046719764	0.19863256
29.463709	0.00073817134	13.398005	0.032244101	0.28379212	0.00047963037	0.20067649
31.672985	0.00067769439	13.702679	0.032445289	0.29349944	0.00048956221	0.20276396
33.856865	0.00076647021	13.976722	0.032564566	0.30299705	0.00049973805	0.20472625

RESULTS

I [dB]	σI [dB]	G [V/K]	σG [V/K]
-13.396556	-0.16724035	0.0047126478	2.1844208e-05

L	σL	T_{noise} [K]	σT_{noise} [K]
0.0023979271	0.00070435482	28.157807	0.13250953

COMMENTS

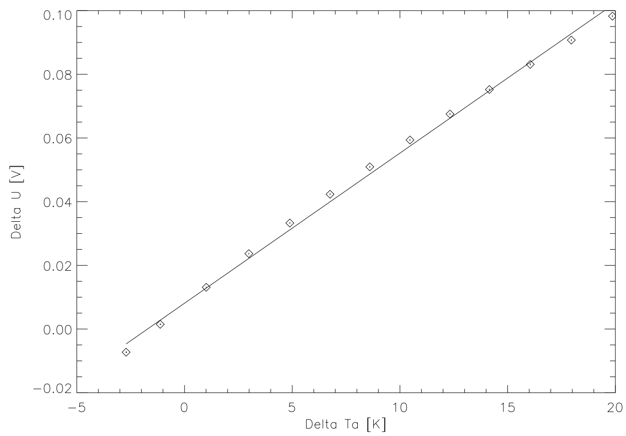


Figure 4.4: Response linearity (differenced values)

4.3 rana_ling_mini_report_003

RANA_LING 003

Linearity, Isolation and Gain

Data from file set: 044LFI25_RCA_FM_LIS_200605210014
Contained in directory: /moredata

INPUT
Channel: C
Sky temperature source: RMON_TEMP
Ref temperature source: SMON_TMP
Changing voltage channel: Ref

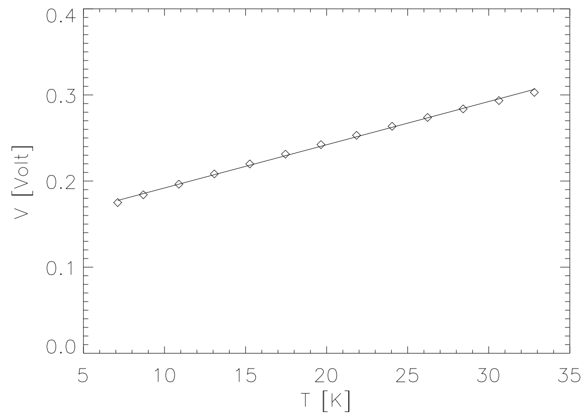


Figure 4.5: Response linearity (changing temperature vs changing voltage

44.0 GHz radiometer							
T_{change} [K]	σT_{change} [K]	T_{fixed} [K]	σT_{fixed} [K]	V_{change} [V]	σV_{change} [V]	V_{fixed} [V]	
8.1223745	0.00042347269	10.846000	0.0000000	0.16921562	0.00029148996	0.17611753	0
9.7139883	0.00060673745	10.846000	0.0000000	0.17771464	0.00030416836	0.17652121	0
11.909742	0.00091583247	10.897799	0.0066026850	0.18907254	0.00031755410	0.17727355	0
14.101342	0.0012341442	11.111430	0.026637109	0.19999912	0.00032535300	0.17873269	0
16.293688	0.0012931669	11.390529	0.036719218	0.21048210	0.00033685062	0.18062265	0
18.493631	0.0013365383	11.728599	0.034446672	0.22061918	0.00034628240	0.18290114	0
20.687546	0.00050393690	12.052341	0.052445188	0.23031339	0.00035751839	0.18506189	0
20.687557	0.00050342607	12.061239	0.040844720	0.23031730	0.00035672455	0.18511761	0
22.884945	0.00047951937	12.387382	0.045796119	0.23977924	0.00036561599	0.18736955	0
25.079781	0.00059969845	12.736526	0.040339023	0.24882316	0.00037356838	0.18968596	0
27.267576	0.00060476240	13.097185	0.023153100	0.25765978	0.00037322793	0.19217663	0
29.463579	0.00075745821	13.381475	0.039499480	0.26608394	0.00038447604	0.19407064	0
31.672956	0.00069503492	13.694785	0.039554790	0.27423251	0.00038972907	0.19612538	0
33.856831	0.00075666938	13.965352	0.043571893	0.28208615	0.00039369978	0.19797529	0

RESULTS

I [dB]	σI [dB]	G [V/K]	σG [V/K]
-12.108357	-0.067726181	0.0040831472	2.2537374e-05

L	σL	T_{noise} [K]	σT_{noise} [K]
0.0027473649	0.00060519852	31.744662	0.15261619

COMMENTS

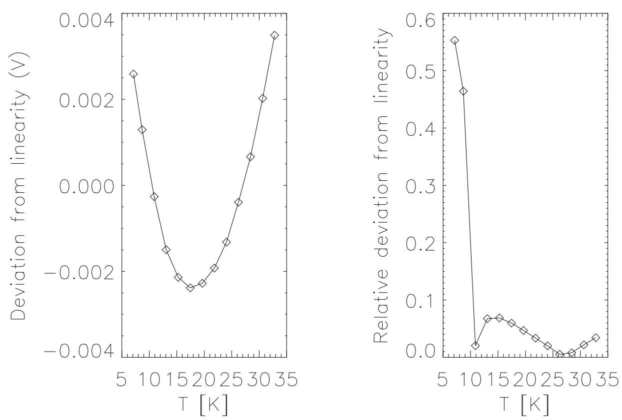


Figure 4.6: Deviation from linearity

4.4 rana_ling_mini_report_004

RANA_LING 004

Linearity, Isolation and Gain

Data from file set: 044LFI25_RCA_FM_LIS_200605210014
Contained in directory: /moredata

INPUT
Channel: D
Sky temperature source: RMON_TEMP
Ref temperature source: SMON_TMP
Changing voltage channel: Ref

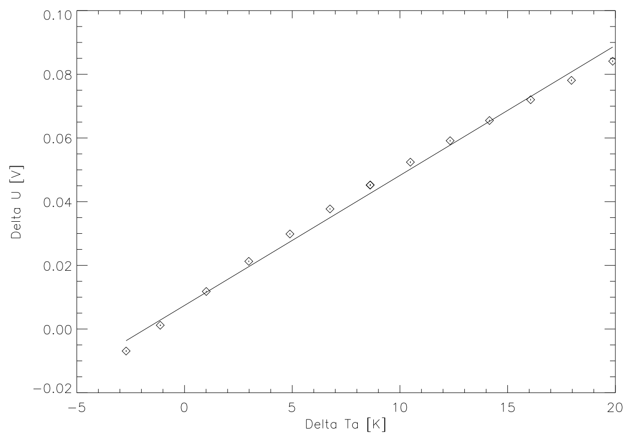


Figure 4.7: Response linearity (differenced values)

44.0 GHz radiometer							
T_{change} [K]	σT_{change} [K]	T_{fixed} [K]	σT_{fixed} [K]	V_{change} [V]	σV_{change} [V]	V_{fixed} [V]	
8.1223726	0.00042420698	10.846000	0.0000000	0.16888924	0.00029027245	0.17677535	0
9.7139854	0.00059695513	10.846000	0.0000000	0.17737158	0.00030328126	0.17717385	0
11.909720	0.00091288338	10.897181	0.0070676664	0.18876213	0.00031680677	0.17793073	0
14.101216	0.0012417050	11.118424	0.020557193	0.19980377	0.00032850427	0.17951845	0
16.293558	0.0012030798	11.403550	0.035276819	0.21034048	0.00033861791	0.18146636	0
18.493633	0.0013364778	11.723660	0.038061414	0.22056201	0.00034783156	0.18366923	0
20.687559	0.00050384307	12.051123	0.038631249	0.23041052	0.00035689084	0.18593912	0
22.884949	0.00048080983	12.390699	0.051654067	0.23994139	0.00036756766	0.18829931	0
25.079781	0.00059969845	12.736526	0.040339023	0.24913219	0.00037801726	0.19064447	0
27.267548	0.00060911034	13.093114	0.024523761	0.25803978	0.00038355831	0.19310770	0
29.463528	0.00075517170	13.373593	0.042100545	0.26654958	0.00038779125	0.19498690	0
31.672989	0.00067431759	13.702969	0.030896382	0.27490549	0.00039509543	0.19723750	0
33.856853	0.00075851800	13.973493	0.036205437	0.28289436	0.00040163381	0.19910083	0

RESULTS

I [dB]	σI [dB]	G [V/K]	σG [V/K]
-11.983385	-0.068304518	0.0040981767	2.1865103e-05

L	σL	T_{noise} [K]	σT_{noise} [K]
0.0027748010	0.00062045673	31.233676	0.15184576

COMMENTS

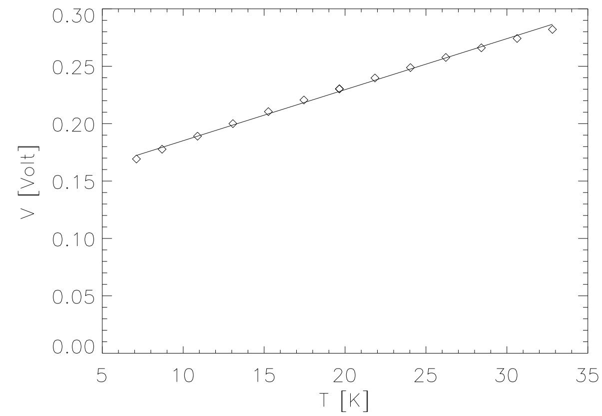


Figure 4.8: Response linearity (changing temperature vs changing voltage

4.5 rana_ling_mini_report_005

RANA_LING 005

Linearity, Isolation and Gain

Data from file set: 044LFI25_RCA_FM_LIS_200605220154
Contained in directory: /moredata

INPUT
Channel: A
Sky temperature source: SMON_TMP
Ref temperature source: RMON_TEMP
Changing voltage channel: Sky

44.0 GHz radiometer						
T_{change} [K]	σT_{change} [K]	T_{fixed} [K]	σT_{fixed} [K]	V_{change} [V]	σV_{change} [V]	V_{fixed} [V]
10.846000	0.0000000	9.7140198	0.00061427971	0.16207414	0.00026082093	0.16292442
16.249411	0.00076470093	9.5068340	0.0012398893	0.18939112	0.00030200323	0.16329621
19.437681	0.0024268704	10.622848	0.010369997	0.20418999	0.00031892020	0.16922700
22.588179	0.0029288861	11.723482	0.0017054104	0.21792118	0.00033142573	0.17481394
25.728100	0.0042623514	12.781887	0.10185567	0.23137999	0.00034999861	0.18040762
28.859777	0.0027574631	13.783707	0.075847201	0.24442218	0.00035940052	0.18577640

RESULTS

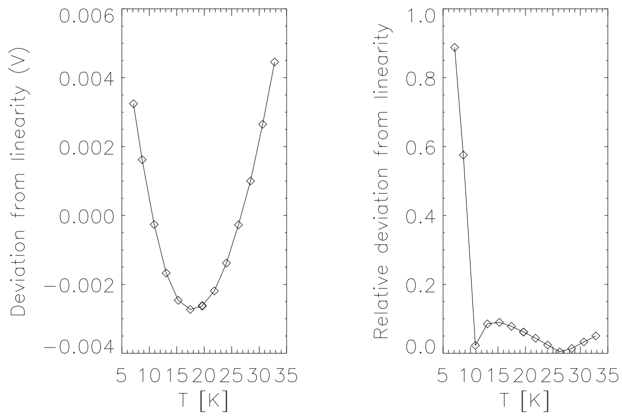


Figure 4.9: Deviation from linearity

I [dB]	σI [dB]	G [V/K]	σG [V/K]
-12.783009	-0.023298035	0.0043693945	4.2980296e-05

L	σL	T_{noise} [K]	σT_{noise} [K]
0.0012885398	0.00057892251	25.705712	0.19585759

COMMENTS

4.6 rana_ling_mini_report_006

RANA_LING 006

Linearity, Isolation and Gain

Data from file set: 044LFI25_RCA_FM_LIS_200605220154
Contained in directory: /moredata

INPUT
Channel: B
Sky temperature source: SMON_TMP
Ref temperature source: RMON_TEMP
Changing voltage channel: Sky

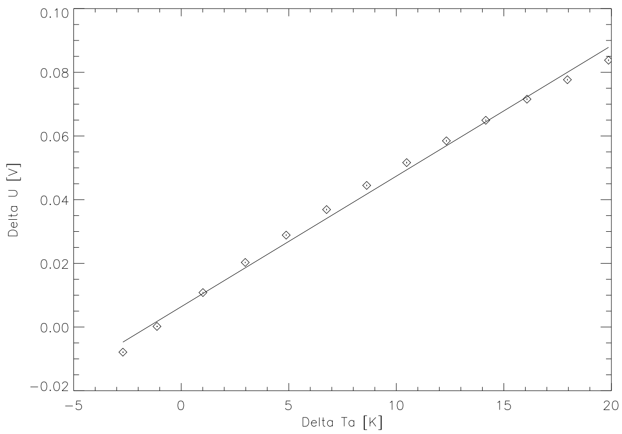


Figure 4.10: Response linearity (differenced values)

44.0 GHz radiometer						
T_{change} [K]	σT_{change} [K]	T_{fixed} [K]	σT_{fixed} [K]	V_{change} [V]	σV_{change} [V]	V_{fixed} [V]
10.846000	0.0000000	9.7140331	0.00060552248	0.18384306	0.00035535825	0.18533590
16.249449	0.00073918002	9.5068407	0.0012486890	0.21554302	0.00039559867	0.18604032
19.439087	0.0015486807	10.622922	0.010366376	0.23267042	0.00042013114	0.19282497
22.588802	0.0028926902	11.723282	0.0016621783	0.24872102	0.00044319884	0.19934044
25.728540	0.0043929378	12.782827	0.10179943	0.26446293	0.00046714131	0.20587499
28.857952	0.0047988123	13.782042	0.076136693	0.27967304	0.00047937281	0.21206770

RESULTS

I [dB]	σI [dB]	G [V/K]	σG [V/K]
-12.465784	-0.025091719	0.0050557709	5.4503317e-05

L	σL	T_{noise} [K]	σT_{noise} [K]
0.0014900319	0.00082749506	24.789839	0.24711143

COMMENTS

4.7 rana_ling_mini_report_007

RANA_LING 007

Linearity, Isolation and Gain

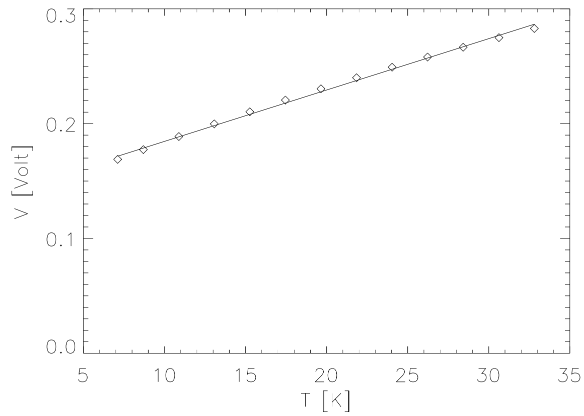


Figure 4.11: Response linearity (changing temperature vs changing voltage

Data from file set: 044LFI25_RCA_FM_LIS_200605220154
Contained in directory: /moredata

INPUT
Channel: C
Sky temperature source: SMON_TMP
Ref temperature source: RMON_TEMP
Changing voltage channel: Sky

44.0 GHz radiometer						
T_{change} [K]	σT_{change} [K]	T_{fixed} [K]	σT_{fixed} [K]	V_{change} [V]	σV_{change} [V]	V_{fixed} [V]
10.846000	0.0000000	9.7140265	0.00060777034	0.17652462	0.00030376282	0.17771812
16.249758	0.00046776736	9.5067329	0.0013081717	0.20480823	0.00033112251	0.17857222
19.439474	0.0014457988	10.622745	0.010415452	0.21988141	0.00034751744	0.18497772
22.590452	0.0020686665	11.722779	0.0014509083	0.23388569	0.00035934079	0.19113950
25.729837	0.0045573860	12.783026	0.10199980	0.24730473	0.00037636611	0.19715151
28.858770	0.0037880649	13.781230	0.075437993	0.26016794	0.00038032225	0.20288703

RESULTS

I [dB]	σI [dB]	G [V/K]	σG [V/K]
-11.290569	-0.012836993	0.0043040610	4.7978765e-05

L	σL	T_{noise} [K]	σT_{noise} [K]
0.0018175884	0.00073256958	28.312200	0.27811828

COMMENTS

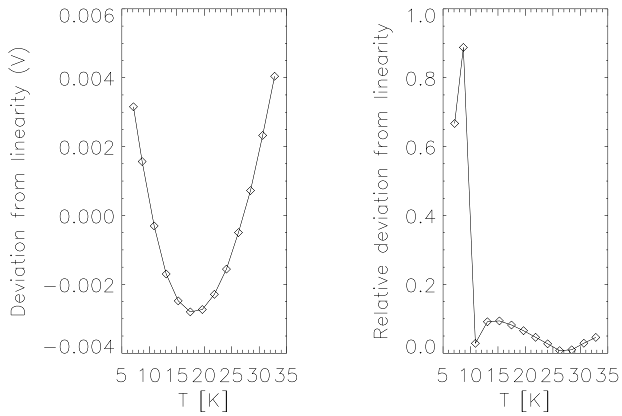


Figure 4.12: Deviation from linearity

4.8 rana_ling_mini_report_008

RANA_LING 008

Linearity, Isolation and Gain

Data from file set: 044LFI25_RCA_FM_LIS_200605220154
Contained in directory: /moredata

INPUT
Channel: D
Sky temperature source: SMON_TMP
Ref temperature source: RMON_TEMP
Changing voltage channel: Sky

44.0 GHz radiometer						
T_{change} [K]	σT_{change} [K]	T_{fixed} [K]	σT_{fixed} [K]	V_{change} [V]	σV_{change} [V]	V_{fixed} [V]
10.846000	0.0000000	9.7140560	0.00061674835	0.17718437	0.00030400376	0.17738263
16.249710	0.00057988637	9.5068216	0.0012684925	0.20558842	0.00033596382	0.17799724
19.439623	0.0011481507	10.622758	0.010403489	0.22082311	0.00035041270	0.18434486
22.590334	0.0019972262	11.722800	0.0014647983	0.23489062	0.00036277923	0.19037635
25.730555	0.0032823654	12.785666	0.10195600	0.24855334	0.00038023167	0.19639170
28.858932	0.0044071293	13.782723	0.076088212	0.26166744	0.00038819689	0.20213882

RESULTS

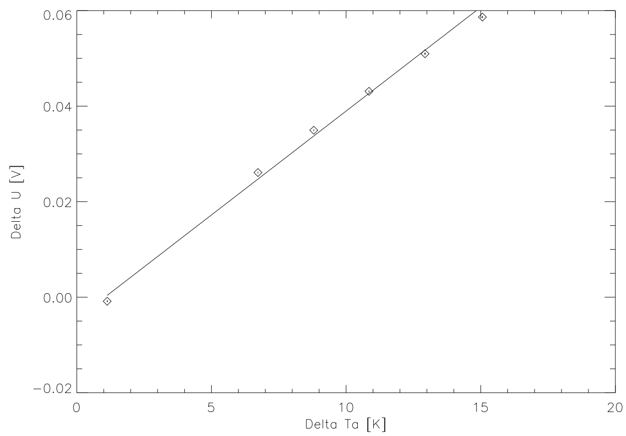


Figure 4.13: Response linearity (differenced values)

I [dB]	σI [dB]	G [V/K]	σG [V/K]
-11.810969	-0.016558630	0.0043898151	4.5622087e-05

L	σL	T_{noise} [K]	σT_{noise} [K]
0.0017404553	0.00068103771	28.096168	0.24990863

COMMENTS

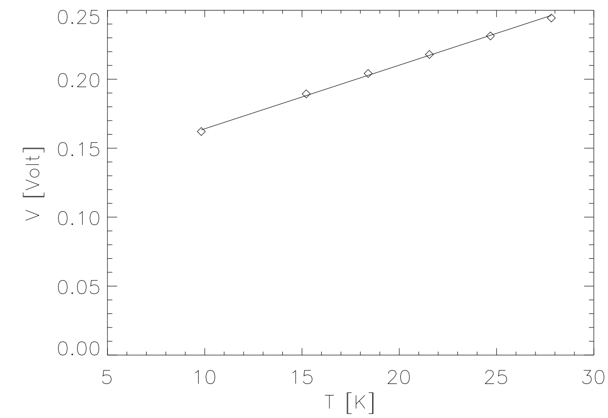


Figure 4.14: Response linearity (changing temperature vs changing voltage

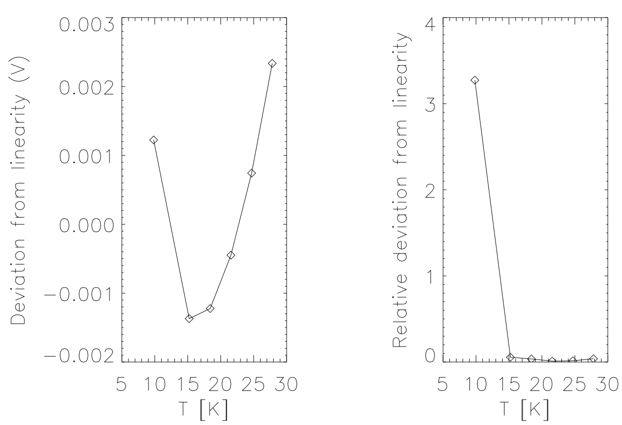


Figure 4.15: Deviation from linearity

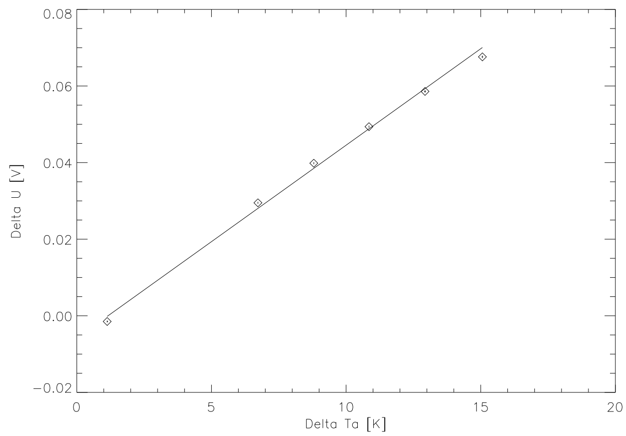


Figure 4.16: Response linearity (differenced values)

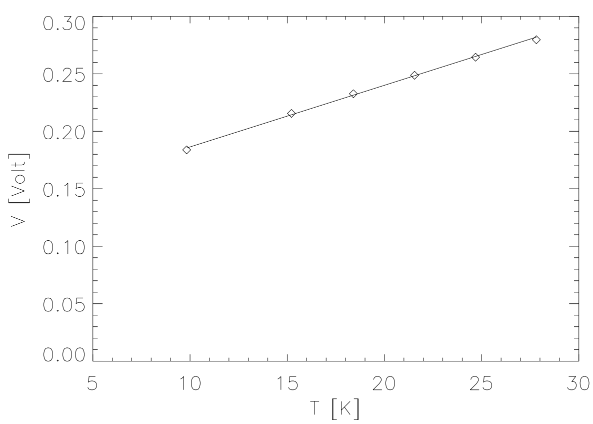


Figure 4.17: Response linearity (changing temperature vs changing voltage

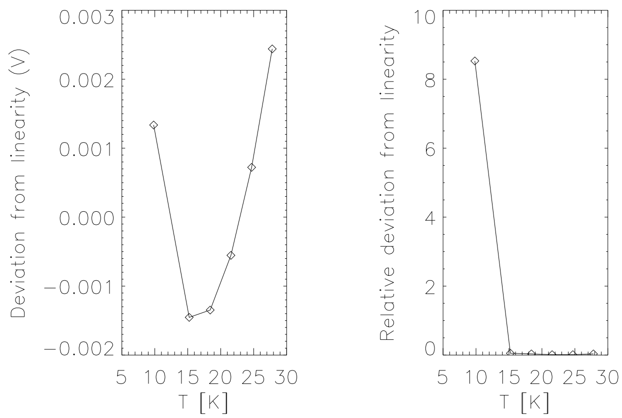


Figure 4.18: Deviation from linearity

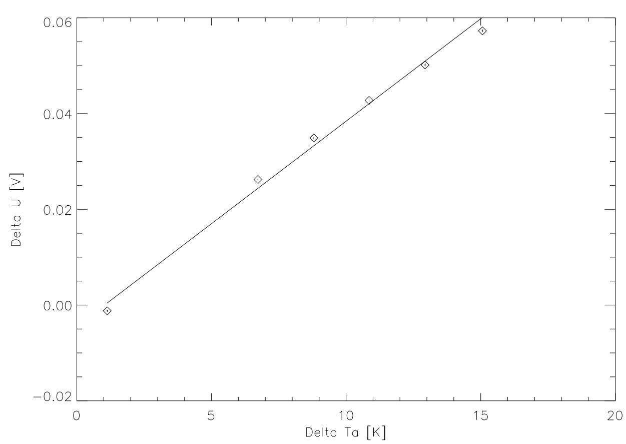


Figure 4.19: Response linearity (differenced values)

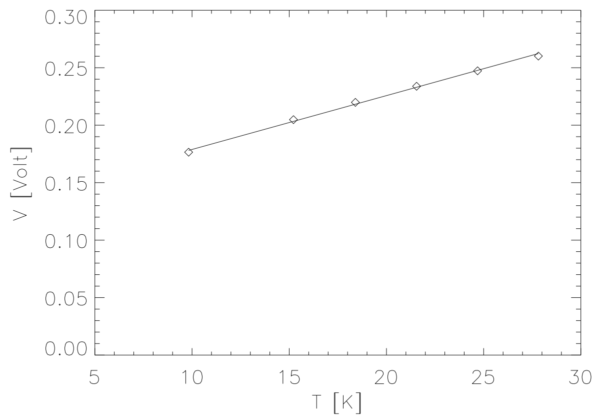


Figure 4.20: Response linearity (changing temperature vs changing voltage

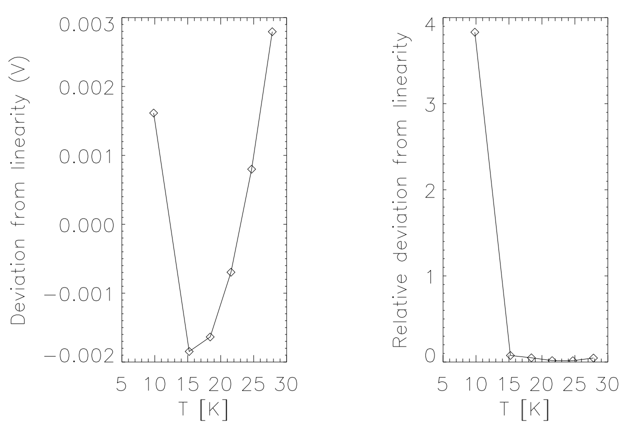


Figure 4.21: Deviation from linearity

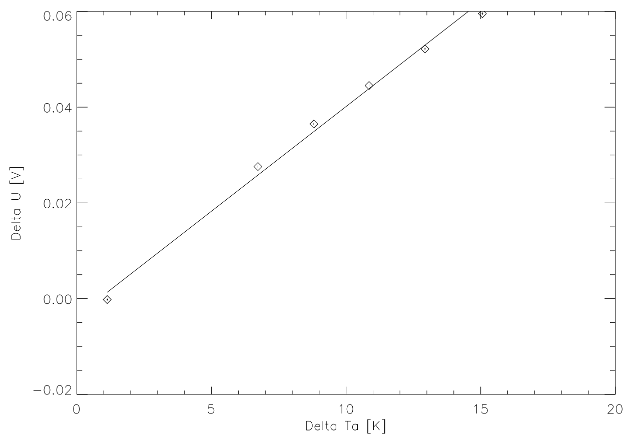


Figure 4.22: Response linearity (differenced values)

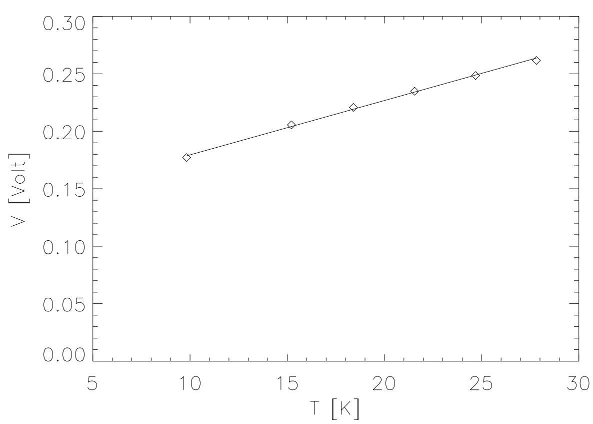


Figure 4.23: Response linearity (changing temperature vs changing voltage

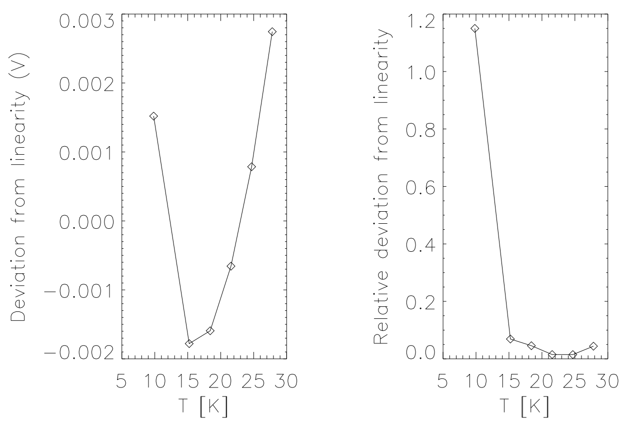


Figure 4.24: Deviation from linearity

Chapter 5

/root/RaNA-Mon-May-22-18:04:20-2006/rana-fft

Chapter 6

/root/RaNA-Mon-May-22-18:04:20-2006/rana-susc

Chapter 7

/root/RaNA-Mon-May-22-18:04:20-2006/rana-spr