SAFARI

On System Analysis of SAFARI FDM :

1. The effect of mismatch, twisted pairs and Zi/o

2. The effect of the length of twisted pairs

SRON

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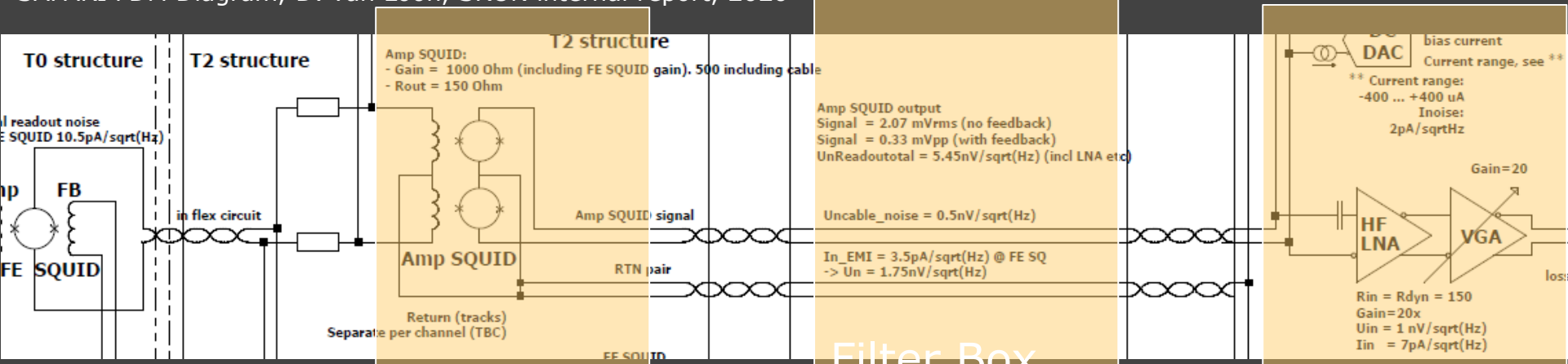
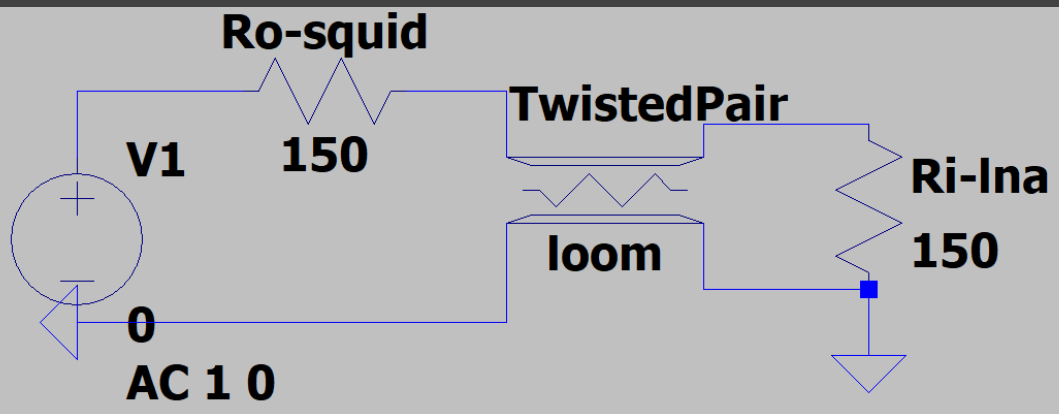
SAFARI FDM Diagram, D. van Loon, SRON internal report, 2020



T2=1.8K

Filter Box
T3=4.8K

WFEE
T4=300K ?



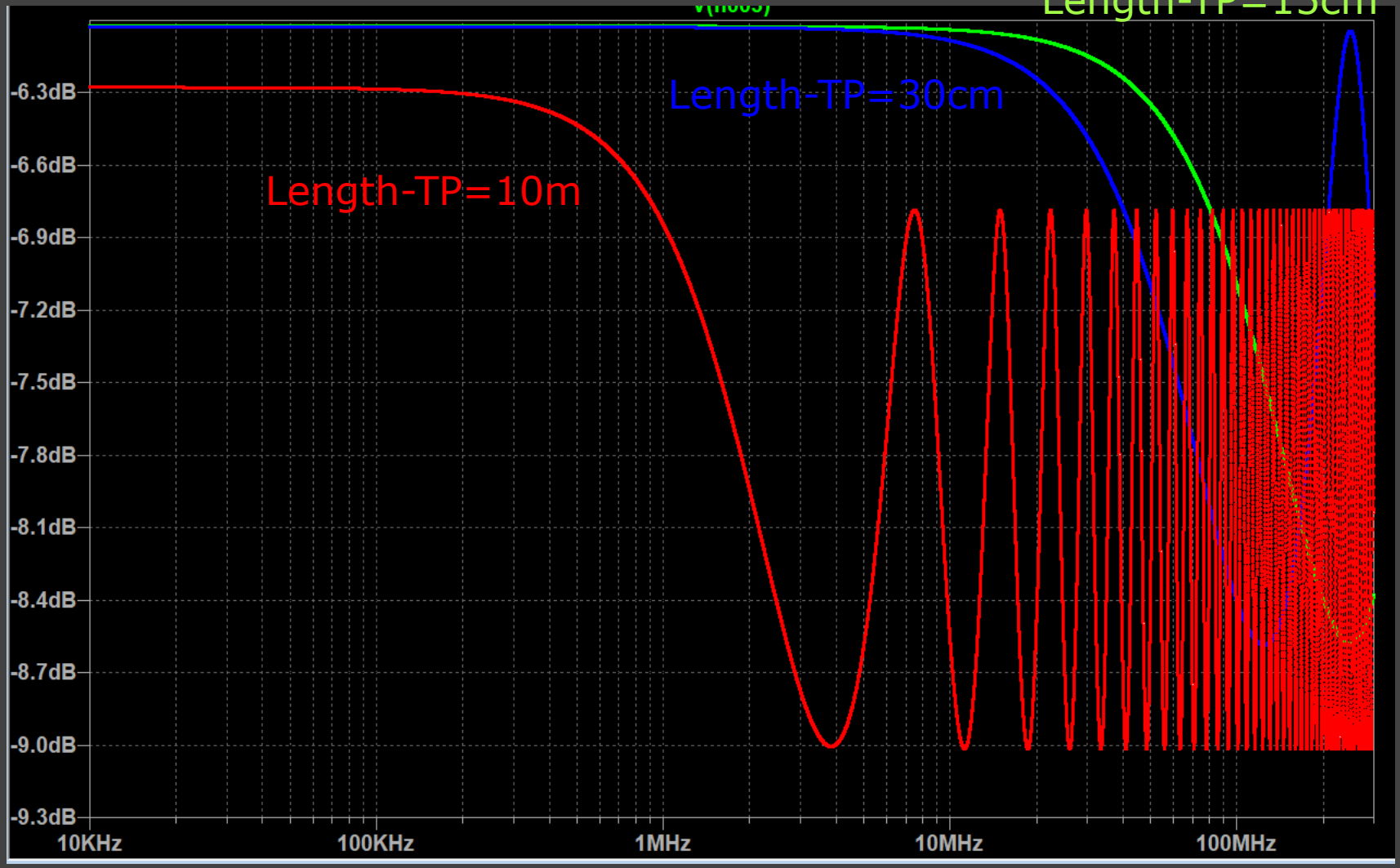
.ac oct 10000 10k 300meg

.model loom LTRA(len={x} L=450nH c=100pF R=0.9)

Z0@SuperConductive=(L/C)^0.5 = 67 Ohm

.step param x list 0.15 0.30 10

Vi-lna (V0-squid=0dB)



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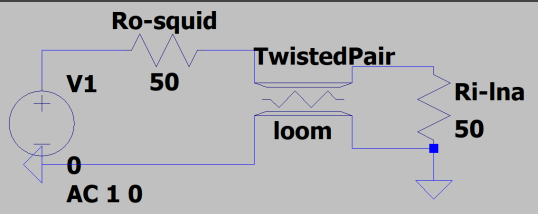
Matched Twisted pair
$Z_{o\text{-}squid}=Z_0=Z_{in\text{-}lna}$ =50 Ohm



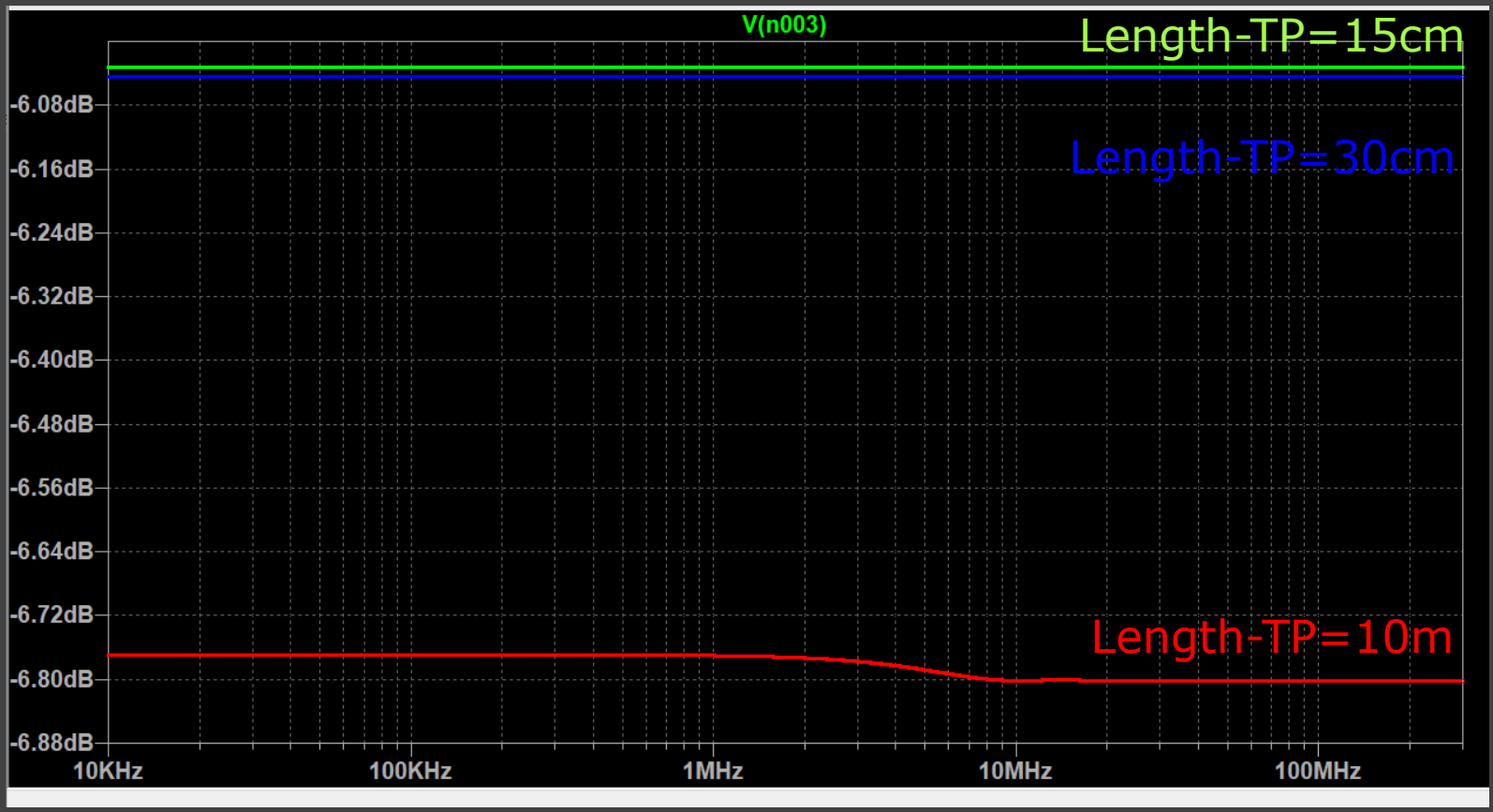
.ac oct 10000 10k 300meg

.model loom LTRA(len={x} L=250nH c=100pF R=0.9)

Z0@SuperConductive=(L/C)^0.5 = 50 Ohm

.step param x list 0.15 0.30 10

Vi-lna (V0-squid=0dB)



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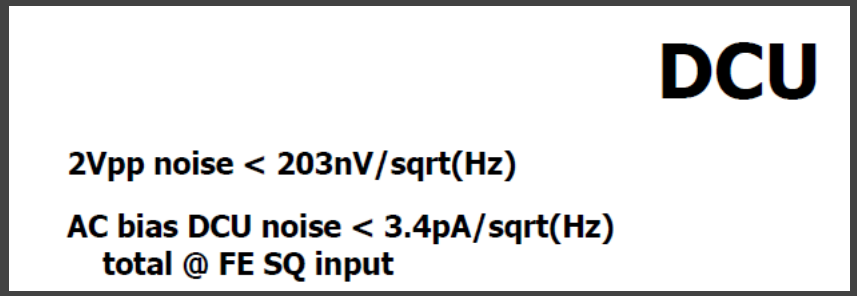
Similar results would be for a 150 Ohm match ($Z_{o\text{-}squid}=Z_0=Z_{in\text{-}lna}$ =150 Ohm)

- Z0 Cryo. twisted pair = 150 Ohm e.g. L=2250 nH C=100 pF OBRs
- ==========
- Bandwidth



- FEE or FDM BW?
- FEE BW 20 MHz

(S/N)=0.7/(9^e-4) ~ 58dB 10+1(sign) bit is needed

- FDM BW 3 MHz

(S/N) ~ 66dB 11+1(sign)bit is needed 12-bit digitizer

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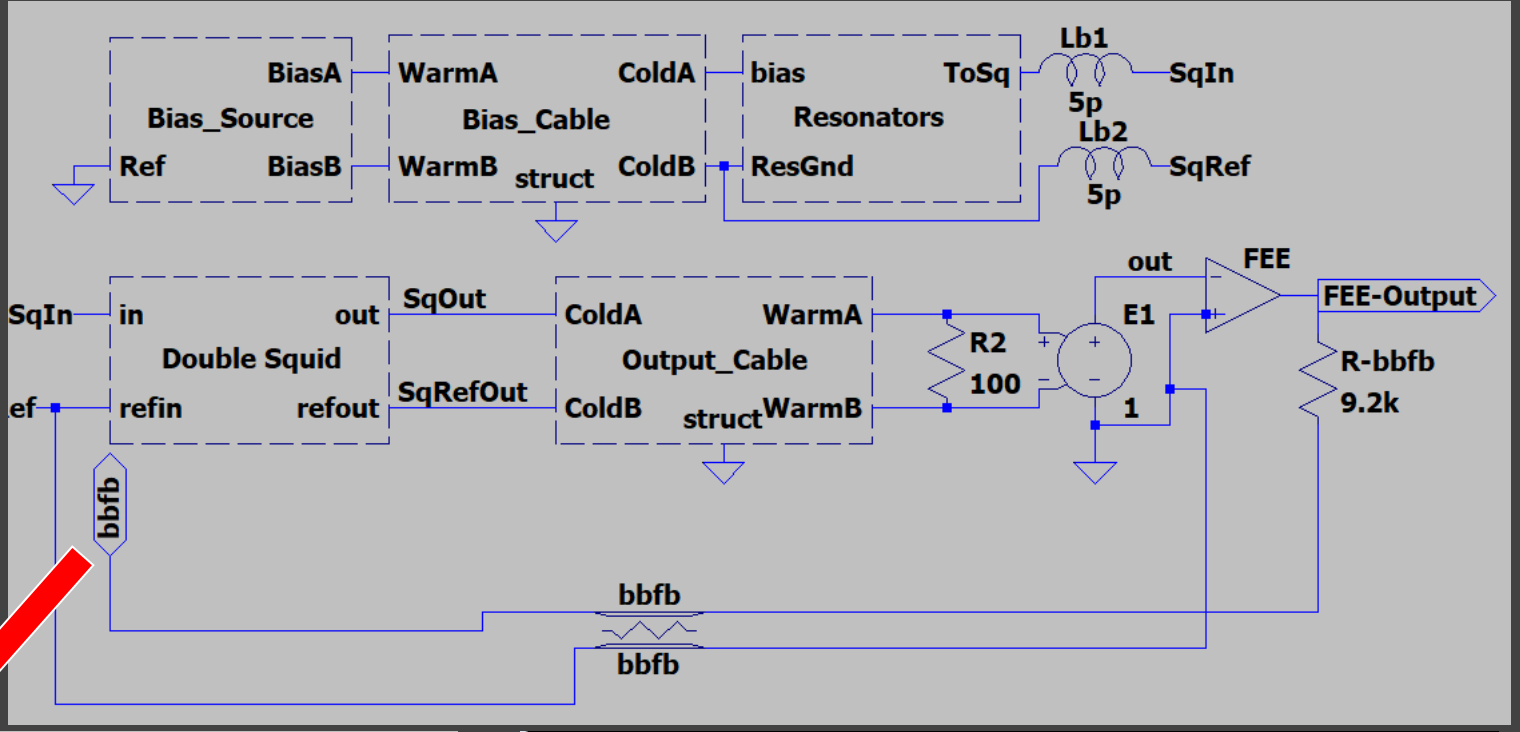
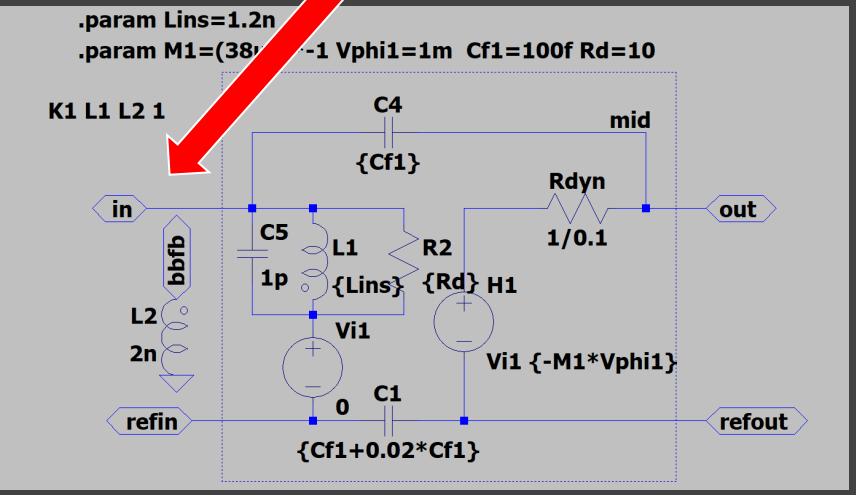
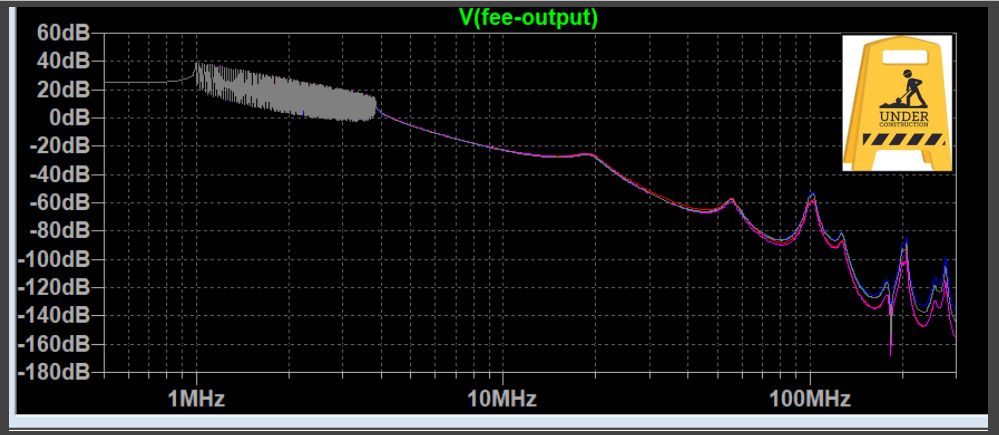
Modification – last presentation







On SAFARI FDM System Diagram

- Transformers (is it in use in the lab setup?)
- Amp squid Twisted pair passess through filter?
- LPF ? 1-4 MHz?

Table 7.2: Harness Load and Dissipation for harness Baseline

				High Common Mode Rejection			Lower Common Mode Rejection		
	Temp. Range (K)	Physical Length (m)	Thermal Length (m)	Thermal Harness resistance (1 ch)	Heat conduc-tion (40ch)	Dissipa-tion 40(ch)	Thermal Harness resistance (1 ch)	Heat conduc-tion (40ch)	Dissipa-tion 40(ch)
50mK SQUIDS						<40nW		<40nW	
1.7K SQUIDS						< 4μW		<4μW	
Divider Networks	4.5K					1.5mW		1.5mW	
FPI to FPIA (IOB) **	4.5 – 4.5	1.7 – 2.4							
FPIA (IOB) to TOB **	4.5 – 4.5	2.0 – 2.5 (2.25)							
TOB to Telescope Shell	4.5 – 30.0	0.8 – 0.9 (0.85)	0.6	0.85Ω	1.5mW	0.9mW 0.5mW	1.61Ω	0.8mW	0.9mW 0.5mW
Telescope Shell to Inner Shield	30.0 – 56.4	0.9 – 1.0 (0.95)	0.416	0.59Ω	5.6mW	1.0mW0 0.9mW	1.1Ω	3.0mW	1.0mW 1.0mW
Inner Shield to Middle Shield	56.4 – 88.0	0.2	0.105	0.15Ω	45mW	0.2mW 0.04mW	0.28Ω	24mW	0.2mW 0.06mW
Middle Shield to Outer Shield	88.0– 136.1	0.2	0.105	0.15Ω	106mW	0.2mW 0.05mW	0.28Ω	56mW	0.2mW 0.07mW
LNA						200mW			200mW
Outer Shield to Main Truss	136.1 – 241.4	1.3 – 1.5 (1.40)	0.88	1.25Ω	47mW	0.9mW 3.2mW	2.4Ω	25mW	0.9mW 5.6mW
Main Truss to PLM/BM	241.4 – 253.0	0.4 – 5.6							
Total	4.5 – 136.1	5.95							

Resistance of DCU - FPA wiring, van Leeuwen, de Korte, SRON report, 2011