

## POLARBEAR 8.2.1 Detectors

This document reports noise results. There is one page per detector that describes the parameters used, the noise calculation and a plot of the timestream used and its power spectrum. Also, one plot per comb is shown showing measured and predicted noise as a function of bias frequency.

The demodulator gain and frequency, the carrier gain and amplitude, the nuller gain and amplitude and the SQUID feedback loop, flux bias and current bias are parameters read from the DfMUX and SQUID controller boards. Values of -1 indicates that the value was not known at the time and other values can be wrong (do not trust calculated numbers if a -1 is present).

The voltage bias is calculated using the transfer function (refer to the DfMUXTransferFunctionsMemo memo). R normal is obtained from the width of the peaks in the network analysis. R is assumed to be  $x \times R_n$  for a bolometer in transition where x is the position in the transition (0.8 for 80% in transition for example). The leadlag resistance is assumed to be  $20\Omega$ . The optical loading is approximated by subtracting the power at turnaround when bolometers were tuned from the power at turnaround when bolometers were tuned dark.  $T_c$  is a measured value and the bath temperature is simply the temperature the detectors are heatsunk to. The average thermal conductance is obtained from the bolometer tuning dark and the dynamical G is calculated from it (refer to the BoloNoiseMemo memo).

The list of operations done to the data is also listed. Each of the components of the calculated noise are listed. The predicted noise as well as the measured average noise between two given frequencies with its variance and the ratio of measured over predicted noise are finally listed. The frequencies between which the PSD is averaged are quoted as well.

# b154-w1-c0

Removing gradient  
Applying Hanning window  
Correcting PSD for Hanning window

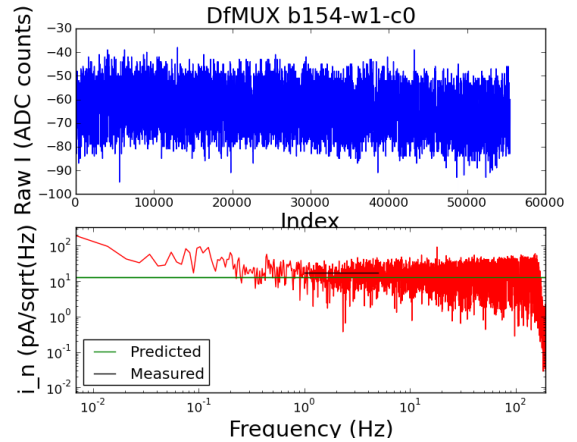
Measured I increased by 5% for DMFD imperfections.

Measured value is the average between 1.0 and 5.0Hz.

Demod gain is : 2  
Demod frequency is : 371430 Hz  
Carrier gain is : 2  
Carrier amplitude : 1.07  
Nuller gain is : 2  
Nuller amplitude : 0.51  
Voltage bias is : 5.69668 uV\_RMS  
R normal is : 1.62 ohm  
R is : 1.296 ohm  
SQUID feedback loop: 10000 ohm  
SQUID flux bias : -0.212158203125 V  
SQUID current bias : 5.37109375 V  
Leadlag R : 10 ohm  
Optical loading : 0.0 pW  
Frequency band : 0 GHz  
Tc is : 0.44 K  
T\_bath is : 0.26 K  
G is guessed : 186.357471013 pW/K  
 $\gamma$  : 0.498

Dark bolo in transition  
SQUID noise : 3.53553390593 pA/sqrt(Hz)  
SQUID ctrl 1st stage noise : 2.91934492474 pA/sqrt(Hz)  
20 ohms noise : 1.67862333172 pA/sqrt(Hz)  
Feedback resistor noise : 1.81971212009 pA/sqrt(Hz)  
SQUID ctrl 2nd stage noise : 0.183847763109 pA/sqrt(Hz)  
Flux bias 50kOhm noise : 0.820243866176 pA/sqrt(Hz)  
Flux bias shot noise : 1.64803121474 pA/sqrt(Hz)  
Current bias shot noise : 3.82603894366 pA/sqrt(Hz)  
Demod digitization stage noise : 0.00810783178394 pA/sqrt(Hz)  
Carrier 1st stage noise : 1.76776695297 pA/sqrt(Hz)  
Carrier 2nd stage noise : 0.459572267319 pA/sqrt(Hz)  
50 Ohm bolo termination noise : 0.735391052434 pA/sqrt(Hz)  
30mOhm resistor noise : 2.87753176233 pA/sqrt(Hz)  
Carrier shot noise : 2.37184549333 pA/sqrt(Hz)  
Carrier digitization noise : 0.339840465876 pA/sqrt(Hz)  
Nuller 1st stage noise : 3.59302226213 pA/sqrt(Hz)  
Nuller 2nd stage noise : 0.934185788153 pA/sqrt(Hz)  
4x820 Ohm resitors noise : 3.11126983722 pA/sqrt(Hz)  
Nuller shot noise : 2.68690263314 pA/sqrt(Hz)  
Nuller digitization noise : 0.895291465886 pA/sqrt(Hz)  
Johnson noise : 6.12221213954 pA/sqrt(Hz)  
Phonon noise : 5.52826007823 pA/sqrt(Hz)

Predicted noise : 12.7529578453 pA/sqrt(Hz)  
Measured noise : 17.3443531682 pA/sqrt(Hz)  
Standard deviation : 9.22014195227 pA/sqrt(Hz)  
Measured/predicted : 1.36002591545



# b154-w1-c1

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Removing gradient  
Applying Hanning window  
Correcting PSD for Hanning window

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Measured I increased by 5% for DMFD imperfections.

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Measured value is the average between 1.0 and 5.0Hz.

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Demod gain is : 2  
Demod frequency is : 455712 Hz  
Carrier gain is : 2  
Carrier amplitude : 1.14  
Nuller gain is : 2  
Nuller amplitude : 0.517  
Voltage bias is : 6.06936 uV\_RMS  
R normal is : 1.69 ohm  
R is : 1.352 ohm  
SQUID feedback loop: 10000 ohm  
SQUID flux bias : -0.212158203125 V  
SQUID current bias : 5.37109375 V  
Leadlag R : 10 ohm  
Optical loading : 0.0 pW  
Frequency band : 0 GHz  
Tc is : 0.44 K  
T\_bath is : 0.26 K  
G is guessed : 186.357471013 pW/K  
 $\gamma$  : 0.498

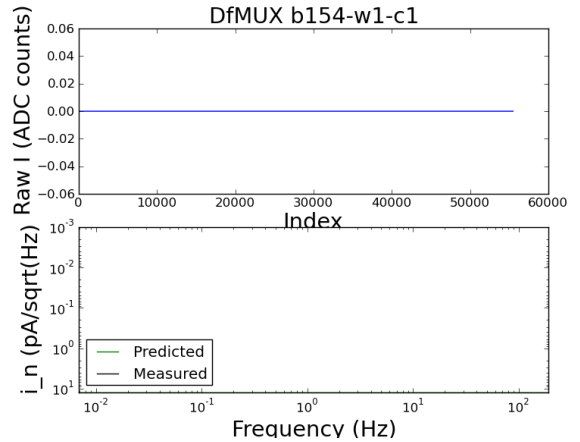
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Dark bolo in transition  
SQUID noise : 3.53553390593 pA/sqrt(Hz)  
SQUID ctrl 1st stage noise : 2.96419004054 pA/sqrt(Hz)  
20 ohms noise : 1.70440927331 pA/sqrt(Hz)  
Feedback resistor noise : 1.81971212009 pA/sqrt(Hz)  
SQUID ctrl 2nd stage noise : 0.183847763109 pA/sqrt(Hz)  
Flux bias 50kOhm noise : 0.820243866176 pA/sqrt(Hz)  
Flux bias shot noise : 1.64803121474 pA/sqrt(Hz)  
Current bias shot noise : 3.88481211501 pA/sqrt(Hz)  
Demod digitization stage noise : 0.00810783178394 pA/sqrt(Hz)  
Carrier 1st stage noise : 1.76776695297 pA/sqrt(Hz)  
Carrier 2nd stage noise : 0.459572267319 pA/sqrt(Hz)  
50 Ohm bolo termination noise : 0.735391052434 pA/sqrt(Hz)  
30mOhm resistor noise : 2.7583440562 pA/sqrt(Hz)  
Carrier shot noise : 2.39696165541 pA/sqrt(Hz)  
Carrier digitization noise : 0.325764233561 pA/sqrt(Hz)  
Nuller 1st stage noise : 3.59302226213 pA/sqrt(Hz)  
Nuller 2nd stage noise : 0.934185788153 pA/sqrt(Hz)  
4x820 Ohm resitors noise : 3.11126983722 pA/sqrt(Hz)  
Nuller shot noise : 2.70527931867 pA/sqrt(Hz)  
Nuller digitization noise : 0.895291465886 pA/sqrt(Hz)  
Johnson noise : 5.99407991962 pA/sqrt(Hz)  
Phonon noise : 5.18880551202 pA/sqrt(Hz)

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Predicted noise : 12.5614303111 pA/sqrt(Hz)  
Measured noise : 0.0 pA/sqrt(Hz)  
Standard deviation : 0.0 pA/sqrt(Hz)  
Measured/predicted : 0.0

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# b154-w1-c2

Removing gradient  
Applying Hanning window  
Correcting PSD for Hanning window

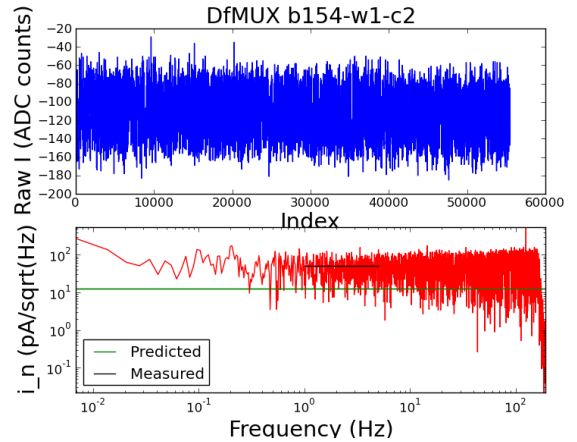
Measured I increased by 5% for DMFD imperfections.

Measured value is the average between 1.0 and 5.0Hz.

Demod gain is : 2  
Demod frequency is : 552291 Hz  
Carrier gain is : 2  
Carrier amplitude : 1.2  
Nuller gain is : 2  
Nuller amplitude : 0.519  
Voltage bias is : 6.3888 uV\_RMS  
R normal is : 1.75 ohm  
R is : 1.4 ohm  
SQUID feedback loop: 10000 ohm  
SQUID flux bias : -0.212158203125 V  
SQUID current bias : 5.37109375 V  
Leadlag R : 10 ohm  
Optical loading : 0.0 pW  
Frequency band : 0 GHz  
Tc is : 0.44 K  
T\_bath is : 0.26 K  
G is guessed : 186.357471013 pW/K  
 $\gamma$  : 0.498

Dark bolo in transition  
SQUID noise : 3.53553390593 pA/sqrt(Hz)  
SQUID ctrl 1st stage noise : 3.02566252855 pA/sqrt(Hz)  
20 ohms noise : 1.73975595391 pA/sqrt(Hz)  
Feedback resistor noise : 1.81971212009 pA/sqrt(Hz)  
SQUID ctrl 2nd stage noise : 0.183847763109 pA/sqrt(Hz)  
Flux bias 50kOhm noise : 0.820243866176 pA/sqrt(Hz)  
Flux bias shot noise : 1.64803121474 pA/sqrt(Hz)  
Current bias shot noise : 3.96537680987 pA/sqrt(Hz)  
Demod digitization stage noise : 0.00810783178394 pA/sqrt(Hz)  
Carrier 1st stage noise : 1.76776695297 pA/sqrt(Hz)  
Carrier 2nd stage noise : 0.459572267319 pA/sqrt(Hz)  
50 Ohm bolo termination noise : 0.735391052434 pA/sqrt(Hz)  
30mOhm resistor noise : 2.66377225998 pA/sqrt(Hz)  
Carrier shot noise : 2.41670484042 pA/sqrt(Hz)  
Carrier digitization noise : 0.314595174125 pA/sqrt(Hz)  
Nuller 1st stage noise : 3.59302226213 pA/sqrt(Hz)  
Nuller 2nd stage noise : 0.934185788153 pA/sqrt(Hz)  
4x820 Ohm resitors noise : 3.11126983722 pA/sqrt(Hz)  
Nuller shot noise : 2.71050691643 pA/sqrt(Hz)  
Nuller digitization noise : 0.895291465886 pA/sqrt(Hz)  
Johnson noise : 5.89042807079 pA/sqrt(Hz)  
Phonon noise : 4.92936523642 pA/sqrt(Hz)

Predicted noise : 12.4361744689 pA/sqrt(Hz)  
Measured noise : 50.3828653834 pA/sqrt(Hz)  
Standard deviation : 26.7264581383 pA/sqrt(Hz)  
Measured/predicted : 4.05131541935



# b154-w1-c3

Removing gradient  
Applying Hanning window  
Correcting PSD for Hanning window

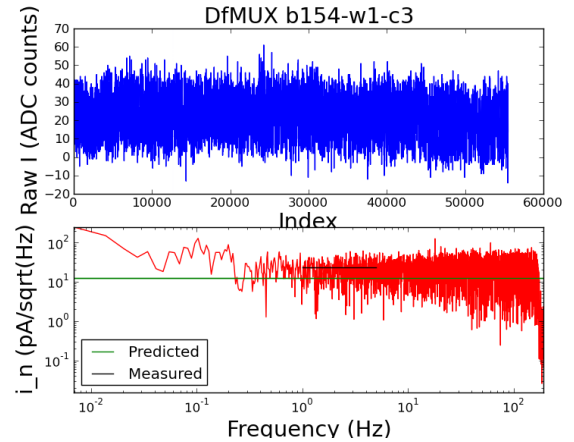
Measured I increased by 5% for DMFD imperfections.

Measured value is the average between 1.0 and 5.0Hz.

Demod gain is : 2  
Demod frequency is : 624378 Hz  
Carrier gain is : 2  
Carrier amplitude : 1.18  
Nuller gain is : 2  
Nuller amplitude : 0.488  
Voltage bias is : 6.28232 uV\_RMS  
R normal is : 1.72 ohm  
R is : 1.376 ohm  
SQUID feedback loop: 10000 ohm  
SQUID flux bias : -0.212158203125 V  
SQUID current bias : 5.37109375 V  
Leadlag R : 10 ohm  
Optical loading : 0.0 pW  
Frequency band : 0 GHz  
Tc is : 0.44 K  
T\_bath is : 0.26 K  
G is guessed : 186.357471013 pW/K  
 $\gamma$  : 0.498

Dark bolo in transition  
SQUID noise : 3.53553390593 pA/sqrt(Hz)  
SQUID ctrl 1st stage noise : 3.07818534218 pA/sqrt(Hz)  
20 ohms noise : 1.76995657176 pA/sqrt(Hz)  
Feedback resistor noise : 1.81971212009 pA/sqrt(Hz)  
SQUID ctrl 2nd stage noise : 0.183847763109 pA/sqrt(Hz)  
Flux bias 50kOhm noise : 0.820243866176 pA/sqrt(Hz)  
Flux bias shot noise : 1.64803121474 pA/sqrt(Hz)  
Current bias shot noise : 4.03421222864 pA/sqrt(Hz)  
Demod digitization stage noise : 0.00810783178394 pA/sqrt(Hz)  
Carrier 1st stage noise : 1.76776695297 pA/sqrt(Hz)  
Carrier 2nd stage noise : 0.459572267319 pA/sqrt(Hz)  
50 Ohm bolo termination noise : 0.735391052434 pA/sqrt(Hz)  
30mOhm resistor noise : 2.71023340405 pA/sqrt(Hz)  
Carrier shot noise : 2.41729021159 pA/sqrt(Hz)  
Carrier digitization noise : 0.320082299255 pA/sqrt(Hz)  
Nuller 1st stage noise : 3.59302226213 pA/sqrt(Hz)  
Nuller 2nd stage noise : 0.934185788153 pA/sqrt(Hz)  
4x820 Ohm resitors noise : 3.11126983722 pA/sqrt(Hz)  
Nuller shot noise : 2.6283109953 pA/sqrt(Hz)  
Nuller digitization noise : 0.895291465886 pA/sqrt(Hz)  
Johnson noise : 5.94157601831 pA/sqrt(Hz)  
Phonon noise : 5.01291379975 pA/sqrt(Hz)

Predicted noise : 12.5255214948 pA/sqrt(Hz)  
Measured noise : 23.1050658484 pA/sqrt(Hz)  
Standard deviation : 12.0537054117 pA/sqrt(Hz)  
Measured/predicted : 1.84463903223



# b154-w1-c4

Removing gradient  
Applying Hanning window  
Correcting PSD for Hanning window

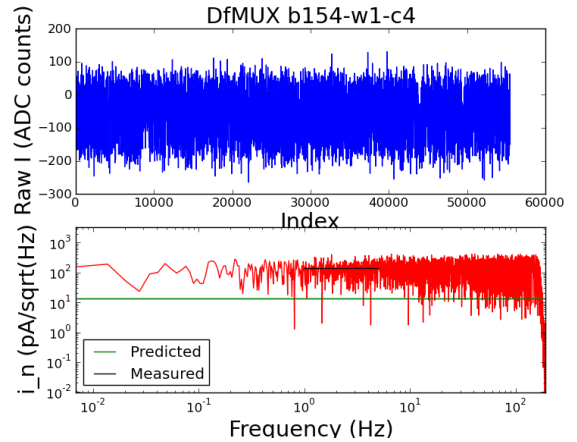
Measured I increased by 5% for DMFD imperfections.

Measured value is the average between 1.0 and 5.0Hz.

Demod gain is : 2  
Demod frequency is : 793674 Hz  
Carrier gain is : 2  
Carrier amplitude : 0.99  
Nuller gain is : 2  
Nuller amplitude : 1.011  
Voltage bias is : 5.27076 uV\_RMS  
R normal is : 1.59 ohm  
R is : 1.272 ohm  
SQUID feedback loop: 10000 ohm  
SQUID flux bias : -0.212158203125 V  
SQUID current bias : 5.37109375 V  
Leadlag R : 10 ohm  
Optical loading : 0.0 pW  
Frequency band : 0 GHz  
Tc is : 0.44 K  
T\_bath is : 0.26 K  
G is guessed : 186.357471013 pW/K  
 $\gamma$  : 0.498

Dark bolo in transition  
SQUID noise : 3.53553390593 pA/sqrt(Hz)  
SQUID ctrl 1st stage noise : 3.22202162327 pA/sqrt(Hz)  
20 ohms noise : 1.85266243338 pA/sqrt(Hz)  
Feedback resistor noise : 1.81971212009 pA/sqrt(Hz)  
SQUID ctrl 2nd stage noise : 0.183847763109 pA/sqrt(Hz)  
Flux bias 50kOhm noise : 0.820243866176 pA/sqrt(Hz)  
Flux bias shot noise : 1.64803121474 pA/sqrt(Hz)  
Current bias shot noise : 4.22272137269 pA/sqrt(Hz)  
Demod digitization stage noise : 0.00810783178394 pA/sqrt(Hz)  
Carrier 1st stage noise : 1.76776695297 pA/sqrt(Hz)  
Carrier 2nd stage noise : 0.459572267319 pA/sqrt(Hz)  
50 Ohm bolo termination noise : 0.735391052434 pA/sqrt(Hz)  
30mOhm resistor noise : 2.93182481445 pA/sqrt(Hz)  
Carrier shot noise : 2.30287862312 pA/sqrt(Hz)  
Carrier digitization noise : 0.346252550138 pA/sqrt(Hz)  
Nuller 1st stage noise : 3.59302226213 pA/sqrt(Hz)  
Nuller 2nd stage noise : 0.934185788153 pA/sqrt(Hz)  
4x820 Ohm resitors noise : 3.11126983722 pA/sqrt(Hz)  
Nuller shot noise : 3.78305293857 pA/sqrt(Hz)  
Nuller digitization noise : 0.895291465886 pA/sqrt(Hz)  
Johnson noise : 6.17969896073 pA/sqrt(Hz)  
Phonon noise : 5.97498816536 pA/sqrt(Hz)

Predicted noise : 13.4625271576 pA/sqrt(Hz)  
Measured noise : 143.133946945 pA/sqrt(Hz)  
Standard deviation : 73.0693892154 pA/sqrt(Hz)  
Measured/predicted : 10.6320266076



# b154-w1-c5

Removing gradient  
Applying Hanning window  
Correcting PSD for Hanning window

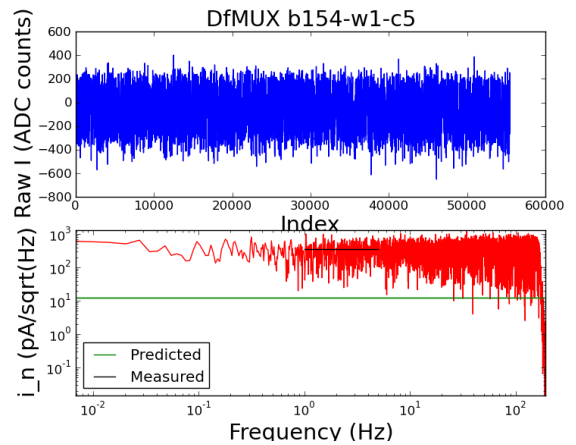
Measured I increased by 5% for DMFD imperfections.

Measured value is the average between 1.0 and 5.0Hz.

Demod gain is : 2  
Demod frequency is : 867507 Hz  
Carrier gain is : 2  
Carrier amplitude : 1.19  
Nuller gain is : 2  
Nuller amplitude : 0.535  
Voltage bias is : 6.33556 uV\_RMS  
R normal is : 1.79 ohm  
R is : 1.432 ohm  
SQUID feedback loop: 10000 ohm  
SQUID flux bias : -0.212158203125 V  
SQUID current bias : 5.37109375 V  
Leadlag R : 10 ohm  
Optical loading : 0.0 pW  
Frequency band : 0 GHz  
Tc is : 0.44 K  
T\_bath is : 0.26 K  
G is guessed : 186.357471013 pW/K  
 $\gamma$  : 0.498

Dark bolo in transition  
SQUID noise : 3.53553390593 pA/sqrt(Hz)  
SQUID ctrl 1st stage noise : 3.29298213095 pA/sqrt(Hz)  
20 ohms noise : 1.8934647253 pA/sqrt(Hz)  
Feedback resistor noise : 1.81971212009 pA/sqrt(Hz)  
SQUID ctrl 2nd stage noise : 0.183847763109 pA/sqrt(Hz)  
Flux bias 50kOhm noise : 0.820243866176 pA/sqrt(Hz)  
Flux bias shot noise : 1.64803121474 pA/sqrt(Hz)  
Current bias shot noise : 4.31572088897 pA/sqrt(Hz)  
Demod digitization stage noise : 0.00810783178394 pA/sqrt(Hz)  
Carrier 1st stage noise : 1.76776695297 pA/sqrt(Hz)  
Carrier 2nd stage noise : 0.459572267319 pA/sqrt(Hz)  
50 Ohm bolo termination noise : 0.735391052434 pA/sqrt(Hz)  
30mOhm resistor noise : 2.60424662289 pA/sqrt(Hz)  
Carrier shot noise : 2.37957270373 pA/sqrt(Hz)  
Carrier digitization noise : 0.307565114368 pA/sqrt(Hz)  
Nuller 1st stage noise : 3.59302226213 pA/sqrt(Hz)  
Nuller 2nd stage noise : 0.934185788153 pA/sqrt(Hz)  
4x820 Ohm resitors noise : 3.11126983722 pA/sqrt(Hz)  
Nuller shot noise : 2.7519702324 pA/sqrt(Hz)  
Nuller digitization noise : 0.895291465886 pA/sqrt(Hz)  
Johnson noise : 5.82424138489 pA/sqrt(Hz)  
Phonon noise : 4.9707884737 pA/sqrt(Hz)

Predicted noise : 12.6163547065 pA/sqrt(Hz)  
Measured noise : 346.008076162 pA/sqrt(Hz)  
Standard deviation : 188.543738204 pA/sqrt(Hz)  
Measured/predicted : 27.4253605112



# b154-w1-c6

Removing gradient  
Applying Hanning window  
Correcting PSD for Hanning window

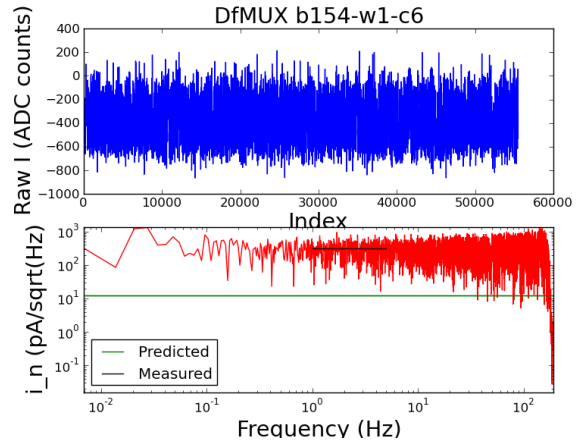
Measured I increased by 5% for DMFD imperfections.

Measured value is the average between 1.0 and 5.0Hz.

Demod gain is : 2  
Demod frequency is : 945012 Hz  
Carrier gain is : 2  
Carrier amplitude : 1.26  
Nuller gain is : 2  
Nuller amplitude : 0.536  
Voltage bias is : 6.70824 uV\_RMS  
R normal is : 1.83 ohm  
R is : 1.464 ohm  
SQUID feedback loop: 10000 ohm  
SQUID flux bias : -0.212158203125 V  
SQUID current bias : 5.37109375 V  
Leadlag R : 10 ohm  
Optical loading : 0.0 pW  
Frequency band : 0 GHz  
Tc is : 0.44 K  
T\_bath is : 0.26 K  
G is guessed : 186.357471013 pW/K  
 $\gamma$  : 0.498

Dark bolo in transition  
SQUID noise : 3.53553390593 pA/sqrt(Hz)  
SQUID ctrl 1st stage noise : 3.37234275778 pA/sqrt(Hz)  
20 ohms noise : 1.93909708573 pA/sqrt(Hz)  
Feedback resistor noise : 1.81971212009 pA/sqrt(Hz)  
SQUID ctrl 2nd stage noise : 0.183847763109 pA/sqrt(Hz)  
Flux bias 50kOhm noise : 0.820243866176 pA/sqrt(Hz)  
Flux bias shot noise : 1.64803121474 pA/sqrt(Hz)  
Current bias shot noise : 4.41972944454 pA/sqrt(Hz)  
Demod digitization stage noise : 0.00810783178394 pA/sqrt(Hz)  
Carrier 1st stage noise : 1.76776695297 pA/sqrt(Hz)  
Carrier 2nd stage noise : 0.459572267319 pA/sqrt(Hz)  
50 Ohm bolo termination noise : 0.735391052434 pA/sqrt(Hz)  
30mOhm resistor noise : 2.54732319944 pA/sqrt(Hz)  
Carrier shot noise : 2.42165204077 pA/sqrt(Hz)  
Carrier digitization noise : 0.300842379628 pA/sqrt(Hz)  
Nuller 1st stage noise : 3.59302226213 pA/sqrt(Hz)  
Nuller 2nd stage noise : 0.934185788153 pA/sqrt(Hz)  
4x820 Ohm resitors noise : 3.11126983722 pA/sqrt(Hz)  
Nuller shot noise : 2.75454096648 pA/sqrt(Hz)  
Nuller digitization noise : 0.895291465886 pA/sqrt(Hz)  
Johnson noise : 5.7602367893 pA/sqrt(Hz)  
Phonon noise : 4.69463355849 pA/sqrt(Hz)

Predicted noise : 12.5416530086 pA/sqrt(Hz)  
Measured noise : 315.066527159 pA/sqrt(Hz)  
Standard deviation : 162.279313523 pA/sqrt(Hz)  
Measured/predicted : 25.1216109186





# b155-w1-c0

Removing gradient  
Applying Hanning window  
Correcting PSD for Hanning window

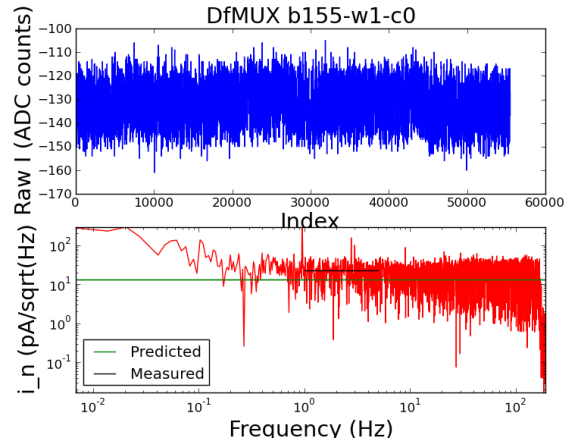
Measured I increased by 5% for DMFD imperfections.

Measured value is the average between 1.0 and 5.0Hz.

Demod gain is : 2  
Demod frequency is : 387135 Hz  
Carrier gain is : 2  
Carrier amplitude : 1.06  
Nuller gain is : 2  
Nuller amplitude : 0.501  
Voltage bias is : 5.64344 uV\_RMS  
R normal is : 1.62 ohm  
R is : 1.296 ohm  
SQUID feedback loop: 10000 ohm  
SQUID flux bias : -0.354431152344 V  
SQUID current bias : 6.32727050781 V  
Leadlag R : 10 ohm  
Optical loading : 0.0 pW  
Frequency band : 0 GHz  
Tc is : 0.44 K  
T\_bath is : 0.26 K  
G is guessed : 186.357471013 pW/K  
 $\gamma$  : 0.498

Dark bolo in transition  
SQUID noise : 3.53553390593 pA/sqrt(Hz)  
SQUID ctrl 1st stage noise : 2.92705892309 pA/sqrt(Hz)  
20 ohms noise : 1.68305888077 pA/sqrt(Hz)  
Feedback resistor noise : 1.81971212009 pA/sqrt(Hz)  
SQUID ctrl 2nd stage noise : 0.183847763109 pA/sqrt(Hz)  
Flux bias 50kOhm noise : 0.820243866176 pA/sqrt(Hz)  
Flux bias shot noise : 2.13010721 pA/sqrt(Hz)  
Current bias shot noise : 4.16363140276 pA/sqrt(Hz)  
Demod digitization stage noise : 0.00810783178394 pA/sqrt(Hz)  
Carrier 1st stage noise : 1.76776695297 pA/sqrt(Hz)  
Carrier 2nd stage noise : 0.459572267319 pA/sqrt(Hz)  
50 Ohm bolo termination noise : 0.735391052434 pA/sqrt(Hz)  
30mOhm resistor noise : 2.87753176233 pA/sqrt(Hz)  
Carrier shot noise : 2.36073608568 pA/sqrt(Hz)  
Carrier digitization noise : 0.339840465876 pA/sqrt(Hz)  
Nuller 1st stage noise : 3.59302226213 pA/sqrt(Hz)  
Nuller 2nd stage noise : 0.934185788153 pA/sqrt(Hz)  
4x820 Ohm resitors noise : 3.11126983722 pA/sqrt(Hz)  
Nuller shot noise : 2.66308914158 pA/sqrt(Hz)  
Nuller digitization noise : 0.895291465886 pA/sqrt(Hz)  
Johnson noise : 6.12221213954 pA/sqrt(Hz)  
Phonon noise : 5.58041347519 pA/sqrt(Hz)

Predicted noise : 12.9466568295 pA/sqrt(Hz)  
Measured noise : 22.6059142664 pA/sqrt(Hz)  
Standard deviation : 13.5717104183 pA/sqrt(Hz)  
Measured/predicted : 1.74608121341



# b155-w1-c1

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Removing gradient  
Applying Hanning window  
Correcting PSD for Hanning window

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Measured I increased by 5% for DMFD imperfections.

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Measured value is the average between 1.0 and 5.0Hz.

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Demod gain is : 2  
Demod frequency is : 467883 Hz  
Carrier gain is : 2  
Carrier amplitude : 1.11  
Nuller gain is : 2  
Nuller amplitude : 0.458  
Voltage bias is : 5.90964 uV\_RMS  
R normal is : 1.69 ohm  
R is : 1.352 ohm  
SQUID feedback loop: 10000 ohm  
SQUID flux bias : -0.354431152344 V  
SQUID current bias : 6.32727050781 V  
Leadlag R : 10 ohm  
Optical loading : 0.0 pW  
Frequency band : 0 GHz  
Tc is : 0.44 K  
T\_bath is : 0.26 K  
G is guessed : 186.357471013 pW/K  
 $\gamma$  : 0.498

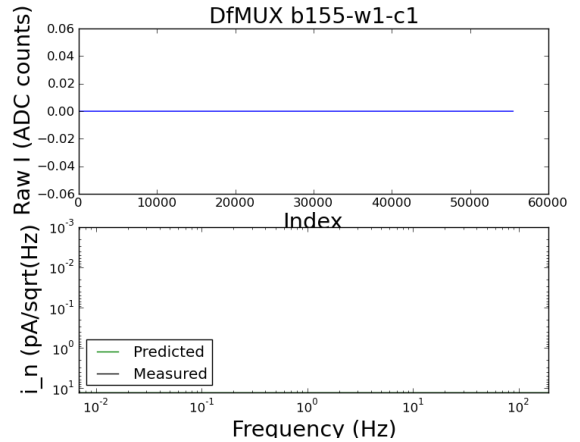
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Dark bolo in transition  
SQUID noise : 3.53553390593 pA/sqrt(Hz)  
SQUID ctrl 1st stage noise : 2.97135554998 pA/sqrt(Hz)  
20 ohms noise : 1.70852944124 pA/sqrt(Hz)  
Feedback resistor noise : 1.81971212009 pA/sqrt(Hz)  
SQUID ctrl 2nd stage noise : 0.183847763109 pA/sqrt(Hz)  
Flux bias 50kOhm noise : 0.820243866176 pA/sqrt(Hz)  
Flux bias shot noise : 2.13010721 pA/sqrt(Hz)  
Current bias shot noise : 4.22664169111 pA/sqrt(Hz)  
Demod digitization stage noise : 0.00810783178394 pA/sqrt(Hz)  
Carrier 1st stage noise : 1.76776695297 pA/sqrt(Hz)  
Carrier 2nd stage noise : 0.459572267319 pA/sqrt(Hz)  
50 Ohm bolo termination noise : 0.735391052434 pA/sqrt(Hz)  
30mOhm resistor noise : 2.7583440562 pA/sqrt(Hz)  
Carrier shot noise : 2.36521241712 pA/sqrt(Hz)  
Carrier digitization noise : 0.325764233561 pA/sqrt(Hz)  
Nuller 1st stage noise : 3.59302226213 pA/sqrt(Hz)  
Nuller 2nd stage noise : 0.934185788153 pA/sqrt(Hz)  
4x820 Ohm resitors noise : 3.11126983722 pA/sqrt(Hz)  
Nuller shot noise : 2.54624142767 pA/sqrt(Hz)  
Nuller digitization noise : 0.895291465886 pA/sqrt(Hz)  
Johnson noise : 5.99407991962 pA/sqrt(Hz)  
Phonon noise : 5.32904349883 pA/sqrt(Hz)

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Predicted noise : 12.7643576021 pA/sqrt(Hz)  
Measured noise : 0.0 pA/sqrt(Hz)  
Standard deviation : 0.0 pA/sqrt(Hz)  
Measured/predicted : 0.0

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# b155-w1-c2

Removing gradient  
Applying Hanning window  
Correcting PSD for Hanning window

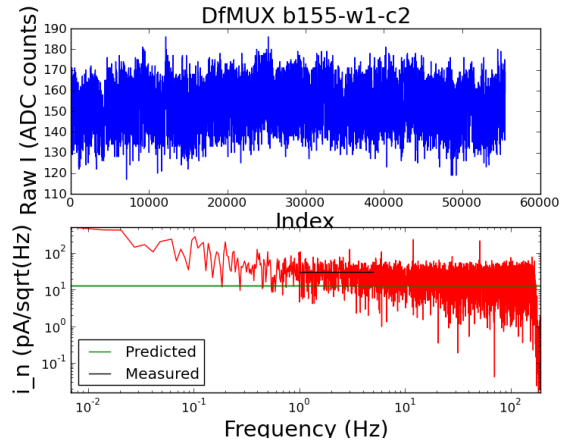
Measured I increased by 5% for DMFD imperfections.

Measured value is the average between 1.0 and 5.0Hz.

Demod gain is : 2  
Demod frequency is : 559284 Hz  
Carrier gain is : 2  
Carrier amplitude : 1.15  
Nuller gain is : 2  
Nuller amplitude : 0.482  
Voltage bias is : 6.1226 uV\_RMS  
R normal is : 1.75 ohm  
R is : 1.4 ohm  
SQUID feedback loop: 10000 ohm  
SQUID flux bias : -0.354431152344 V  
SQUID current bias : 6.32727050781 V  
Leadlag R : 10 ohm  
Optical loading : 0.0 pW  
Frequency band : 0 GHz  
Tc is : 0.44 K  
T\_bath is : 0.26 K  
G is guessed : 186.357471013 pW/K  
 $\gamma$  : 0.498

Dark bolo in transition  
SQUID noise : 3.53553390593 pA/sqrt(Hz)  
SQUID ctrl 1st stage noise : 3.03051514572 pA/sqrt(Hz)  
20 ohms noise : 1.74254620879 pA/sqrt(Hz)  
Feedback resistor noise : 1.81971212009 pA/sqrt(Hz)  
SQUID ctrl 2nd stage noise : 0.183847763109 pA/sqrt(Hz)  
Flux bias 50kOhm noise : 0.820243866176 pA/sqrt(Hz)  
Flux bias shot noise : 2.13010721 pA/sqrt(Hz)  
Current bias shot noise : 4.31079399453 pA/sqrt(Hz)  
Demod digitization stage noise : 0.00810783178394 pA/sqrt(Hz)  
Carrier 1st stage noise : 1.76776695297 pA/sqrt(Hz)  
Carrier 2nd stage noise : 0.459572267319 pA/sqrt(Hz)  
50 Ohm bolo termination noise : 0.735391052434 pA/sqrt(Hz)  
30mOhm resistor noise : 2.66377225998 pA/sqrt(Hz)  
Carrier shot noise : 2.36582114507 pA/sqrt(Hz)  
Carrier digitization noise : 0.314595174125 pA/sqrt(Hz)  
Nuller 1st stage noise : 3.59302226213 pA/sqrt(Hz)  
Nuller 2nd stage noise : 0.934185788153 pA/sqrt(Hz)  
4x820 Ohm resitors noise : 3.11126983722 pA/sqrt(Hz)  
Nuller shot noise : 2.61210337315 pA/sqrt(Hz)  
Nuller digitization noise : 0.895291465886 pA/sqrt(Hz)  
Johnson noise : 5.89042807079 pA/sqrt(Hz)  
Phonon noise : 5.14368546409 pA/sqrt(Hz)

Predicted noise : 12.6794859484 pA/sqrt(Hz)  
Measured noise : 29.5383831893 pA/sqrt(Hz)  
Standard deviation : 17.1745240954 pA/sqrt(Hz)  
Measured/predicted : 2.32961993172



# b155-w1-c3

Removing gradient  
Applying Hanning window  
Correcting PSD for Hanning window

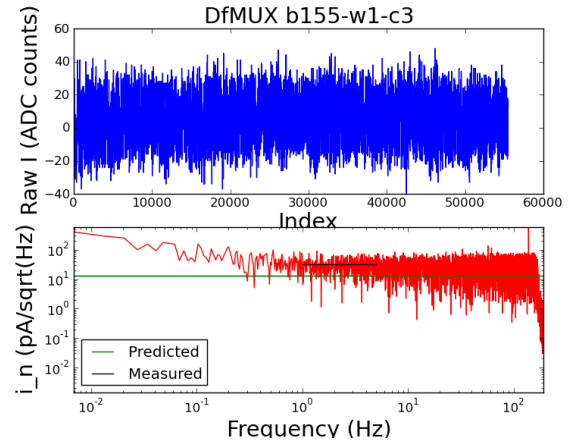
Measured I increased by 5% for DMFD imperfections.

Measured value is the average between 1.0 and 5.0Hz.

Demod gain is : 2  
Demod frequency is : 635034 Hz  
Carrier gain is : 2  
Carrier amplitude : 1.14  
Nuller gain is : 2  
Nuller amplitude : 0.475  
Voltage bias is : 6.06936 uV\_RMS  
R normal is : 1.72 ohm  
R is : 1.376 ohm  
SQUID feedback loop: 10000 ohm  
SQUID flux bias : -0.354431152344 V  
SQUID current bias : 6.32727050781 V  
Leadlag R : 10 ohm  
Optical loading : 0.0 pW  
Frequency band : 0 GHz  
Tc is : 0.44 K  
T\_bath is : 0.26 K  
G is guessed : 186.357471013 pW/K  
 $\gamma$  : 0.498

Dark bolo in transition  
SQUID noise : 3.53553390593 pA/sqrt(Hz)  
SQUID ctrl 1st stage noise : 3.08641022397 pA/sqrt(Hz)  
20 ohms noise : 1.77468587878 pA/sqrt(Hz)  
Feedback resistor noise : 1.81971212009 pA/sqrt(Hz)  
SQUID ctrl 2nd stage noise : 0.183847763109 pA/sqrt(Hz)  
Flux bias 50kOhm noise : 0.820243866176 pA/sqrt(Hz)  
Flux bias shot noise : 2.13010721 pA/sqrt(Hz)  
Current bias shot noise : 4.39030264439 pA/sqrt(Hz)  
Demod digitization stage noise : 0.00810783178394 pA/sqrt(Hz)  
Carrier 1st stage noise : 1.76776695297 pA/sqrt(Hz)  
Carrier 2nd stage noise : 0.459572267319 pA/sqrt(Hz)  
50 Ohm bolo termination noise : 0.735391052434 pA/sqrt(Hz)  
30mOhm resistor noise : 2.71023340405 pA/sqrt(Hz)  
Carrier shot noise : 2.37596596635 pA/sqrt(Hz)  
Carrier digitization noise : 0.320082299255 pA/sqrt(Hz)  
Nuller 1st stage noise : 3.59302226213 pA/sqrt(Hz)  
Nuller 2nd stage noise : 0.934185788153 pA/sqrt(Hz)  
4x820 Ohm resitors noise : 3.11126983722 pA/sqrt(Hz)  
Nuller shot noise : 2.59306644728 pA/sqrt(Hz)  
Nuller digitization noise : 0.895291465886 pA/sqrt(Hz)  
Johnson noise : 5.94157601831 pA/sqrt(Hz)  
Phonon noise : 5.18880551202 pA/sqrt(Hz)

Predicted noise : 12.7745719862 pA/sqrt(Hz)  
Measured noise : 31.6963788168 pA/sqrt(Hz)  
Standard deviation : 16.1143210053 pA/sqrt(Hz)  
Measured/predicted : 2.48120867384



# b155-w1-c4

Removing gradient  
Applying Hanning window  
Correcting PSD for Hanning window

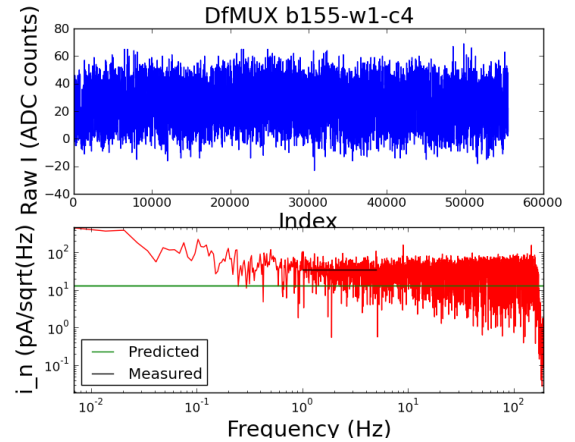
Measured I increased by 5% for DMFD imperfections.

Measured value is the average between 1.0 and 5.0Hz.

Demod gain is : 2  
Demod frequency is : 732033 Hz  
Carrier gain is : 2  
Carrier amplitude : 1.07  
Nuller gain is : 2  
Nuller amplitude : 0.544  
Voltage bias is : 5.69668 uV\_RMS  
R normal is : 1.59 ohm  
R is : 1.272 ohm  
SQUID feedback loop: 10000 ohm  
SQUID flux bias : -0.354431152344 V  
SQUID current bias : 6.32727050781 V  
Leadlag R : 10 ohm  
Optical loading : 0.0 pW  
Frequency band : 0 GHz  
Tc is : 0.44 K  
T\_bath is : 0.26 K  
G is guessed : 186.357471013 pW/K  
 $\gamma$  : 0.498

Dark bolo in transition  
SQUID noise : 3.53553390593 pA/sqrt(Hz)  
SQUID ctrl 1st stage noise : 3.16648545185 pA/sqrt(Hz)  
20 ohms noise : 1.82072913482 pA/sqrt(Hz)  
Feedback resistor noise : 1.81971212009 pA/sqrt(Hz)  
SQUID ctrl 2nd stage noise : 0.183847763109 pA/sqrt(Hz)  
Flux bias 50kOhm noise : 0.820243866176 pA/sqrt(Hz)  
Flux bias shot noise : 2.13010721 pA/sqrt(Hz)  
Current bias shot noise : 4.50420664911 pA/sqrt(Hz)  
Demod digitization stage noise : 0.00810783178394 pA/sqrt(Hz)  
Carrier 1st stage noise : 1.76776695297 pA/sqrt(Hz)  
Carrier 2nd stage noise : 0.459572267319 pA/sqrt(Hz)  
50 Ohm bolo termination noise : 0.735391052434 pA/sqrt(Hz)  
30mOhm resistor noise : 2.93182481445 pA/sqrt(Hz)  
Carrier shot noise : 2.39411683164 pA/sqrt(Hz)  
Carrier digitization noise : 0.346252550138 pA/sqrt(Hz)  
Nuller 1st stage noise : 3.59302226213 pA/sqrt(Hz)  
Nuller 2nd stage noise : 0.934185788153 pA/sqrt(Hz)  
4x820 Ohm resitors noise : 3.11126983722 pA/sqrt(Hz)  
Nuller shot noise : 2.77502110695 pA/sqrt(Hz)  
Nuller digitization noise : 0.895291465886 pA/sqrt(Hz)  
Johnson noise : 6.17969896073 pA/sqrt(Hz)  
Phonon noise : 5.52826007823 pA/sqrt(Hz)

Predicted noise : 13.1804539488 pA/sqrt(Hz)  
Measured noise : 35.1676408916 pA/sqrt(Hz)  
Standard deviation : 18.3278629592 pA/sqrt(Hz)  
Measured/predicted : 2.66816613662



# b155-w1-c5

Removing gradient  
Applying Hanning window  
Correcting PSD for Hanning window

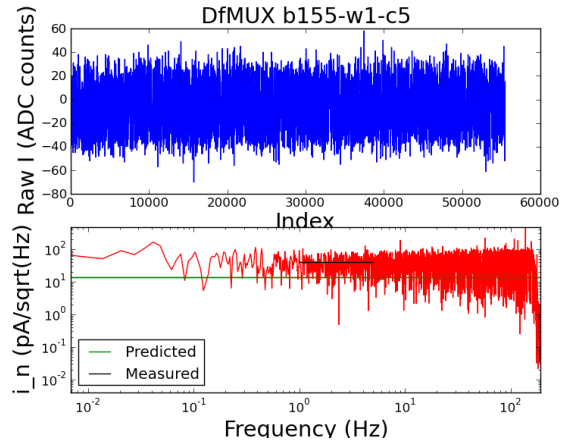
Measured I increased by 5% for DMFD imperfections.

Measured value is the average between 1.0 and 5.0Hz.

Demod gain is : 2  
Demod frequency is : 815388 Hz  
Carrier gain is : 2  
Carrier amplitude : 1.15  
Nuller gain is : 2  
Nuller amplitude : 1.529  
Voltage bias is : 6.1226 uV\_RMS  
R normal is : 1.79 ohm  
R is : 1.432 ohm  
SQUID feedback loop: 10000 ohm  
SQUID flux bias : -0.354431152344 V  
SQUID current bias : 6.32727050781 V  
Leadlag R : 10 ohm  
Optical loading : 0.0 pW  
Frequency band : 0 GHz  
Tc is : 0.44 K  
T\_bath is : 0.26 K  
G is guessed : 186.357471013 pW/K  
 $\gamma$  : 0.498

Dark bolo in transition  
SQUID noise : 3.53553390593 pA/sqrt(Hz)  
SQUID ctrl 1st stage noise : 3.24240127364 pA/sqrt(Hz)  
20 ohms noise : 1.86438073234 pA/sqrt(Hz)  
Feedback resistor noise : 1.81971212009 pA/sqrt(Hz)  
SQUID ctrl 2nd stage noise : 0.183847763109 pA/sqrt(Hz)  
Flux bias 50kOhm noise : 0.820243866176 pA/sqrt(Hz)  
Flux bias shot noise : 2.13010721 pA/sqrt(Hz)  
Current bias shot noise : 4.61219405486 pA/sqrt(Hz)  
Demod digitization stage noise : 0.00810783178394 pA/sqrt(Hz)  
Carrier 1st stage noise : 1.76776695297 pA/sqrt(Hz)  
Carrier 2nd stage noise : 0.459572267319 pA/sqrt(Hz)  
50 Ohm bolo termination noise : 0.735391052434 pA/sqrt(Hz)  
30mOhm resistor noise : 2.60424662289 pA/sqrt(Hz)  
Carrier shot noise : 2.33923804124 pA/sqrt(Hz)  
Carrier digitization noise : 0.307565114368 pA/sqrt(Hz)  
Nuller 1st stage noise : 3.59302226213 pA/sqrt(Hz)  
Nuller 2nd stage noise : 0.934185788153 pA/sqrt(Hz)  
4x820 Ohm resitors noise : 3.11126983722 pA/sqrt(Hz)  
Nuller shot noise : 4.65233076038 pA/sqrt(Hz)  
Nuller digitization noise : 0.895291465886 pA/sqrt(Hz)  
Johnson noise : 5.82424138489 pA/sqrt(Hz)  
Phonon noise : 5.14368546409 pA/sqrt(Hz)

Predicted noise : 13.372735565 pA/sqrt(Hz)  
Measured noise : 40.238898154 pA/sqrt(Hz)  
Standard deviation : 21.2311713654 pA/sqrt(Hz)  
Measured/predicted : 3.00902518849



b154-w1

