NATIONAL RADIO ASTRONOMY OBSERVATORY
Charlottesville, Virginia

April 23, 1986

MEMORANDUM:

TO: A. Dowd

FROM: S. Weinreb

SUBJECT: Theoretical RMS for Hybrid Correlator

I have computed the theoretical spectral fluctuation in terms of the weighting factor, A, defined in Technical Note #165. The technical note also defined a weighting variable B, which we have absorbed into one weighting variable, A', used in the program as,

If $A' < 0$	$A = \|A'\|$	$B = 0$
If $A' \geq 0$	$A = A'$	$B = 2A - 1$

Also note that Table I of Technical Note #165 has errors. Column 1, Uniform Weight, should read from top to bottom: 1, 0, 1, 1.

The rms fluctuation can be calculated from equation 66 of my thesis which, unfortunately, also contains an error (only one I have found in 23 years!); the left hand side should read $\alpha^2/\Delta f$, instead of $\alpha/\Delta f$. The steps are:

$$\frac{\alpha^2}{\Delta f} = \int_{-\infty}^{\infty} w^2(\tau)d\tau \sim \sum_{n=-(N-1)}^{N-1} w^2(n)\cdot\Delta\tau$$

$$w(n) = A + (1-A)\cos(\pi n/N)$$

$$\sigma = \frac{2\alpha\beta}{\sqrt{\Delta f \cdot T}} \qquad \beta = 1.235$$

The summation can be evaluated to give

$$\sigma = \frac{2.47}{\sqrt{f_s T}} \sqrt{N(3A^2 - 2A + 1) - 4A^2 + 4A - 1}$$

The above is a convenient form since it does not involve the half-power resolution, Δf, which is also a function of A.

The difference in rms fluctuation between standard and modified transforms will be small and should be ignored; use $|A'|$ in the above expression in place of A.

The quantity you should plot in the program is σ_x/σ, where σ_x is the experimental rms, on a default scale of 0 to 2.

Some typical numerical values for $f_s = 10^8$, N = 32, and T = 60 sec are:

A	σ	α	Δf MHz	Peak Sidelobe
1	253×10^{-6}	1.099	1.91	- 5.8 dB
.5	~~168×10^{-6}~~ 156×10^{-6}	0.936	3.16	- 15.7 dB

cc: R. Escoffier
R. Freund

HYSPEC MEMO NO. 6

NATIONAL RADIO ASTRONOMY OBSERVATORY
Charlottesville, Virginia

June 30, 1986
(Corrected)

MEMORANDUM:

TO: A. Dowd

FROM: S. Weinreb

SUBJECT: Theoretical RMS for Hybrid Correlator

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If $A' \geq 0$	$A = A'$	$B = 2A - 1$

Also note that Table I of Technical Note #165 has errors. Column 1, Uniform Weight, should read from top to bottom: 1, 0, 1, 1.

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The summation can be evaluated to give

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.5	156×10^{-6}	0.936	3.16	- 15.7 dB