VLBA Acquisition Memo # 079

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To: VLBA Data Acquisition Group

From: Alan E.E. Rogers

Subject: 4-level Sampling and Baseband Conversion AGC

1] Optimum SNR

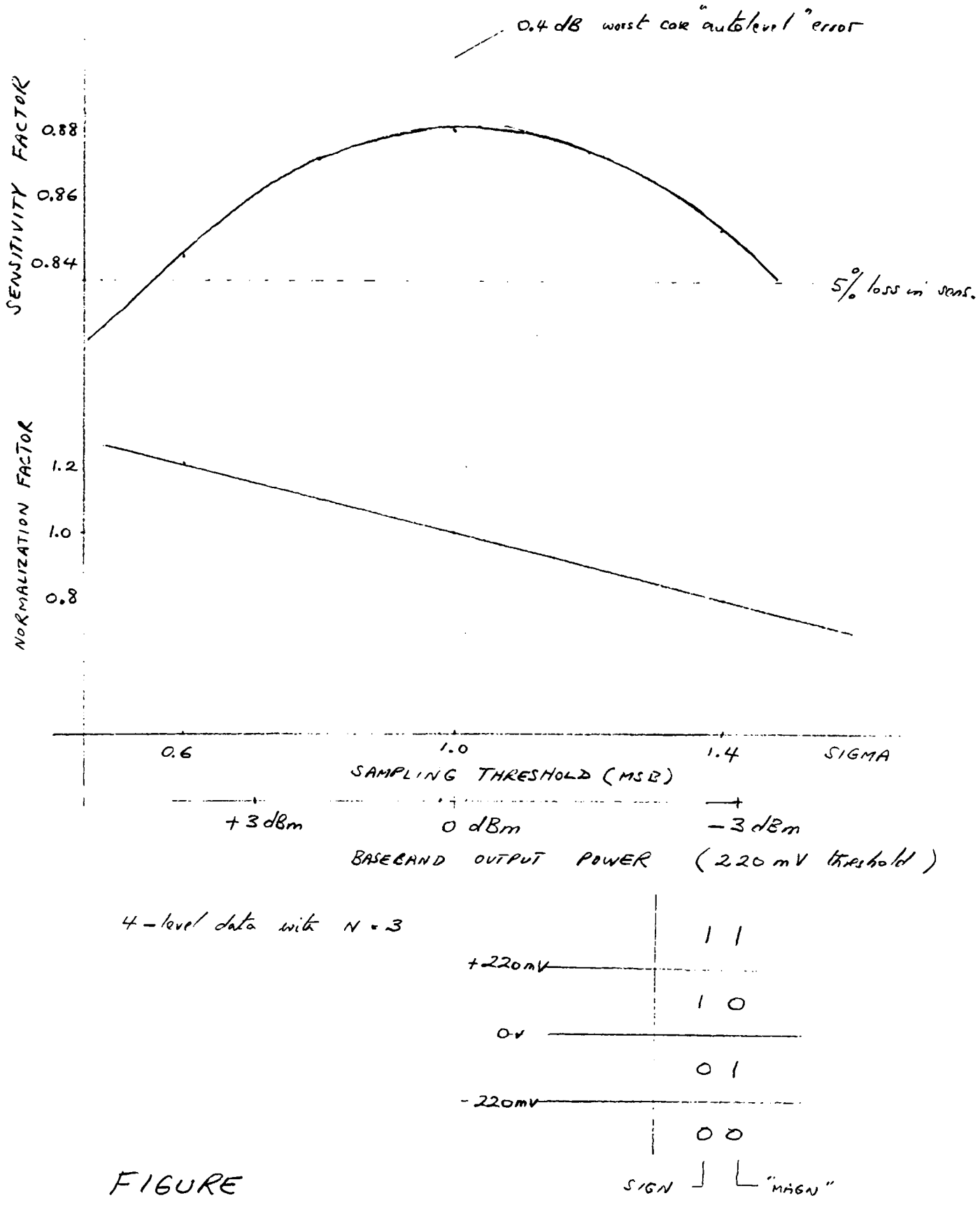
Fred Schwab (see Correlator Memo #75) has shown that optimum SNR is achieved using a weight of 3.338 for codes ØØ and 11. Codes Ø1 and 1Ø having unit weight. For a weight of 3 the SNR is optimized with a threshold very close to 1 sigma. This changes an insignificant amount if a weight of 3 is used instead of 3.336. The baseband converter controls the levels to the sampler to maintain the optimum sampling threshold. The nominal output level of Ø dBm is maintained to within ±Ø.2 dB by means of a digital attenuator under control of the 8751 microprocessor. The nominal sampler threshold of 22Ø mV corresponds to 1 sigma at Ø dBm input. The figure shows that the SNR can be maintained at the optimum value with very little degradation even if the Automatic Gain Control (AGC) or "autolevelling" is in error by 1 dB.

2] Calibration Error Without Processor Normalization

The processor should measure the average thresholds used during an averaging period by counting the number of data points in each state. However if no normalization counts are measured in the processor the correlation amplitudes will have errors which result from an imperfect AGC. The error which results from an AGC error in one station is about 4% per dB. Since the AGC error is likely to be only Ø.2 dB without correction in the processor should be under 1%.

3] Threshold Asymmetry and D.C. Offsets

D.C. offsets in the comparators used in the samplers results in asymmetry of the sampling thresholds and a D.C. correlation which produces an error or spurious response at zero fringe rate. The 5Ø microvolt D.C. offset specified for the samplers will result in a maximum D.C. correlation of 5x1Ø**-8 for 2-level data and 3x1Ø**-7 for 4-level data.


0.4 dB worst case "autolevel" error
SENSITIVITY FACTOR
0.88
0.86
0.84
5% loss in sens.
NORMALIZATION FACTOR
1.2
1.0
0.8
0.6
1.0
1.4
SIGMA
SAMPLING THRESHOLD (MSB)
+3 dBm
0 dBm
−3 dBm
BASEBAND OUTPUT POWER (220 mV threshold)
4-level data with N = 3
+220mV
0V
-220mV
1 1
1 0
0 1
0 0
SIGN
"MAGN"

FIGURE