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GBT9 Implementation

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Abstract

A description is provided for the Matched Filter and Acquisition System.
The CCA performance is described.

The significance of the physical realization of the Matched Filter systems is discussed and shown to be relevant to the ability to easily change the data rates.

Matched Filter Implementation

Fig. 1 depicts the Matched Filter and Acquisition Susbsystem. This block diagram shows the resultant acquisition process and is useful for understanding the operation at a systems level. However, the complexity is a great deal less than this block diagram would indicate, because a single Matched Filter is used to implement all 22 matched filters. This is implemented in a time division method, and is effectively the equivalent of parallel processing.

In Fig. 1, each of the 22 Matched Filters is matched to a different phase of the incoming Barker sequence (11 chips sampled at twice the chip rate) and each matched filter is sampled at the symbol rate (11 chip periods). There are 22 detectors shown in order to simplify the understanding of the acquisition process. The absolute value of the detector outputs are then summed for N samples. The largest summation is indicative of the largest received signal and the corresponding matched filter's reference phase is selected as the correct phase of the incoming Advanced Barker code. The identification of the phase of the incoming spreading sequence is the end result of the acquisition process.

The procesing power inherent in the matched filter is used to implement an acquisition circuit similar in performance to the "parallel corelator" acquisition. The acquisition performance of the parallel correlator is optimal in the sense that it requires the minimum amount of time for acquisition.

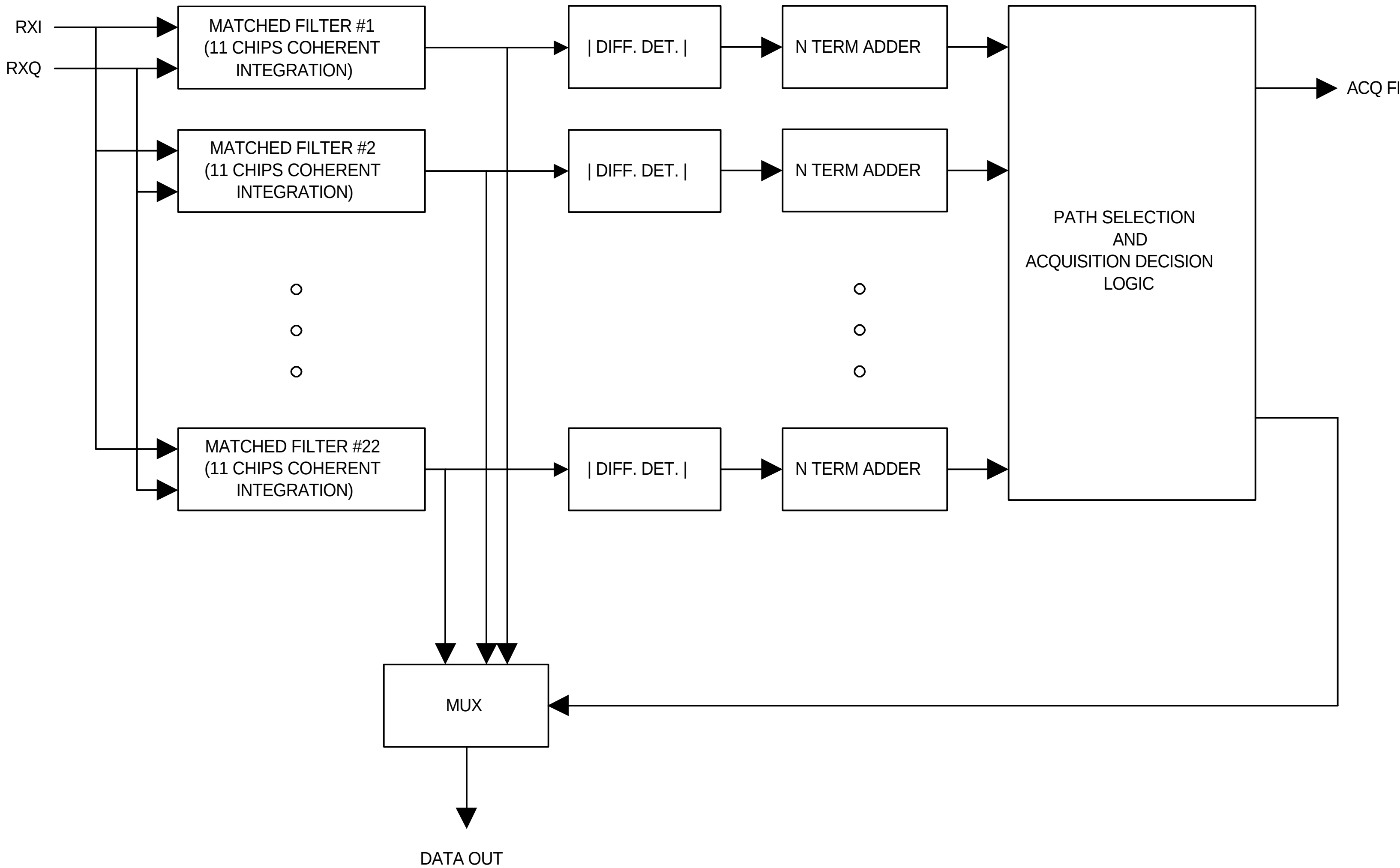


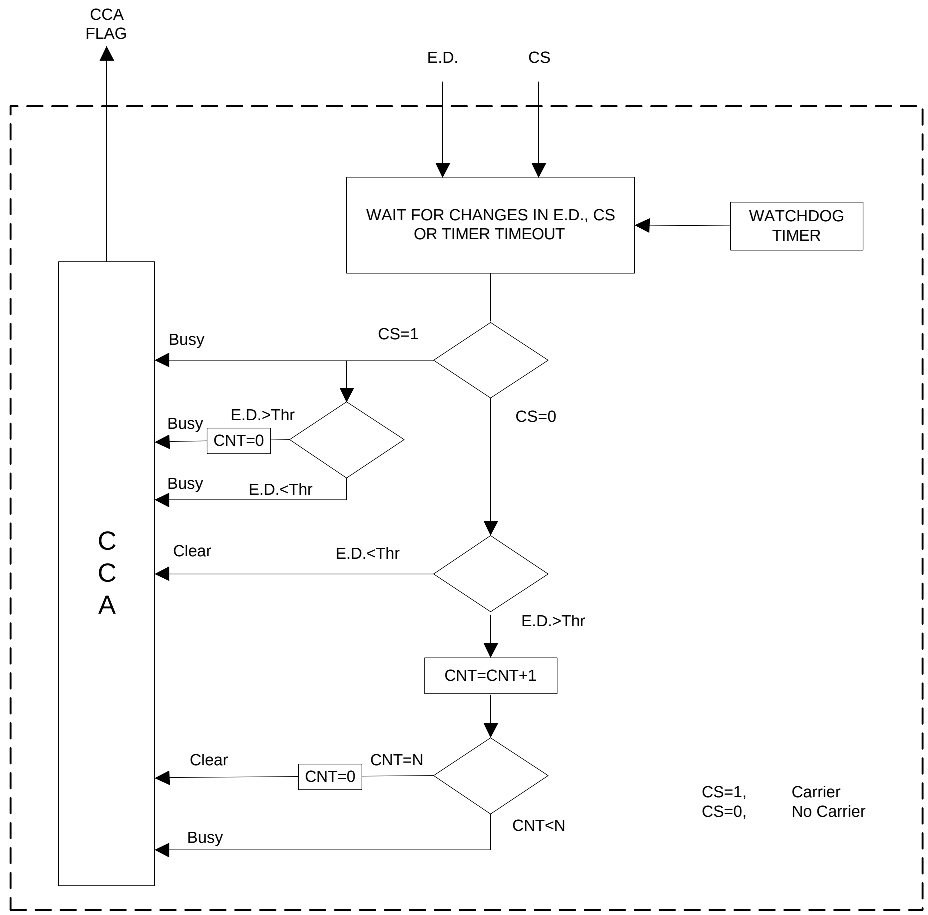
Figure 1. Matched Filter and Acquisition Susbsystem

Clear Channel Assesment

Fig. 2 is a flowchart of the CCA process. The Energy Detection (ED)is straightforward and non-coherent, as it must be for 2.4 Ghz. The interesting part is the algorithm for determining the ED threshold. In the flowchart, the CCA block (on the left) will only receive a Clear or a Busy.

Fig. 3 shows the performance of the CCA system. As with any CCA, there are two possible errors. One is a False Alarm. The probability of False Alarm is the Pfa curve on the left. The other error is to miss an actual signal. This probability is shown in the Pmiss curve on the right. For this chart, the probability is defined as once per symbol. The incoming SNR is 6 dB and 16 incoming symbols are averaged. That is, N=16 in the Matched Filter acquisition slide. Threshold alpha, on the horizontal axis, is a dimensionless number within the loop of the ED threshold algorithm. This algorithm determines the trigger threshold as a function of previous samples.

What is interesting about this chart is that it shows the probability of error is very low, over a broad range of Threshold, from 1.8 to 2.4. The significance is that this allows the system to be very robust.and could maintain this good performance, even if only 32 symbols are assigmed for acquisition, with 16 symbols for each of the two antennas.



<u>Figure 2. Clear Channel Assement (CCA) decision tree</u>

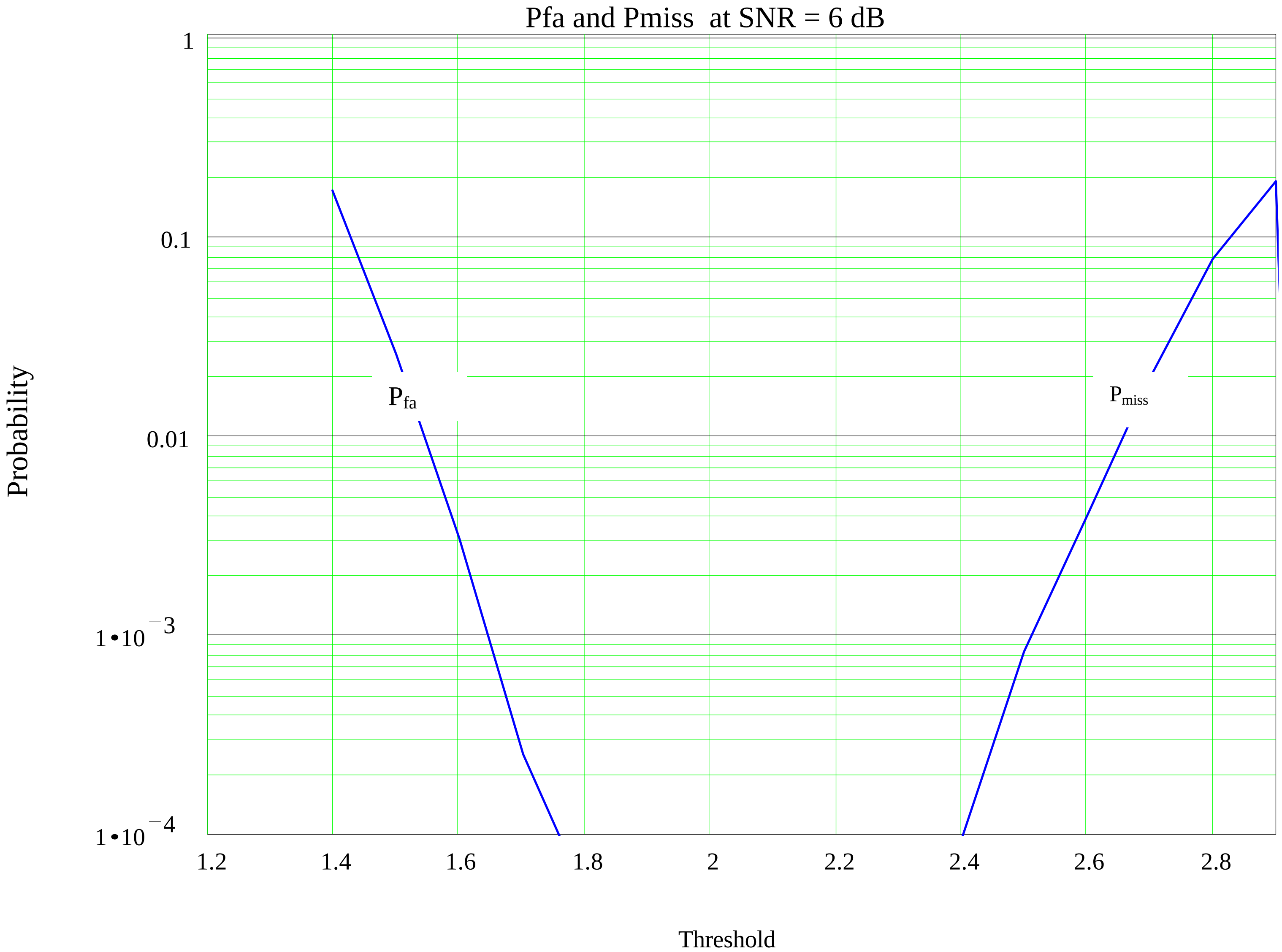


Figure 3. Clear Channel Assement (CCA) Performance: False Alarms and Misses

Discussion

It is of particular importance to the variable data rate implementation of GBT9 that the Matched Filter is implemented with a single structure, be it circuitry or algorithms, and not as many as 22 such structures. This makes it straighforward to change the number of Advanced Barker codes in use, in real time, and with only a minor increase in complexity. Even so, the lower data rate equipment will still cost less to manufacture because the LSI circuits can run slower. Insofar as the implementation is an embedded DSP, a lower data rate also makes possible a simpler DSP.

The CCA system is sufficiently robust that the number of averaged symbols could be reduced, even below 16. This ability is required, if a higher speed preamble would be adopted.

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