A RAM buffer in the test fixture card was used to slow down the high-data-rate filter card output to a clock rate appropriate to the GBT correlator chip.

The filter card was tested in each of the 5 ALMA operating modes going in binary steps from a 128-tap, 1/2 band filter to a 2048-tap, 1/32 band filter. For each of the operating modes, four different filter designs were tested:

1. a sharp cutoff filter with 0.95 band efficiency
2. a more gentle rolloff filter with 0.9 band efficiency
3. a partial band filter with a 0.75 band cutoff
4. a band pass filter

(Band efficiency above is defined as the useable amount of the passband selected. For example, a 1/2 band filter with a 0.95 band efficiency had a designed 3 dB point of 0.95 GHz, so the useable output extends from 0 to 0.95 GHz.)

II. Results of Pass Band Testing

In the figures below, performance in each of the 5 filter modes is described in a set of 8 figures. For 1/2 band operation of the filter, for example, Figures 1A, 2A, 3A, and 4A give the predicted filter performance as calculated by the filter design software, while figures 1B, 2B, 3B, and 4B give corresponding actual filter card performance as measured in the test fixture. Since the filter card output is always Nyquist sampled, only the pass band can be seen in the actual performance figures.

In the partial band and band pass filters, a floor 20 to 25 dB below the pass band signal is seen. This attenuation level is not a measure of the filter rejection in the stop band, but is only the correction level of the quantization correction for the 3-level GBT correlator chip. As mentioned above, the quantization correction used was not strictly correct because of the non-Gaussian nature of the signals.

Fig. 1A. 1/2 band filter design with 0.95 band efficiency.

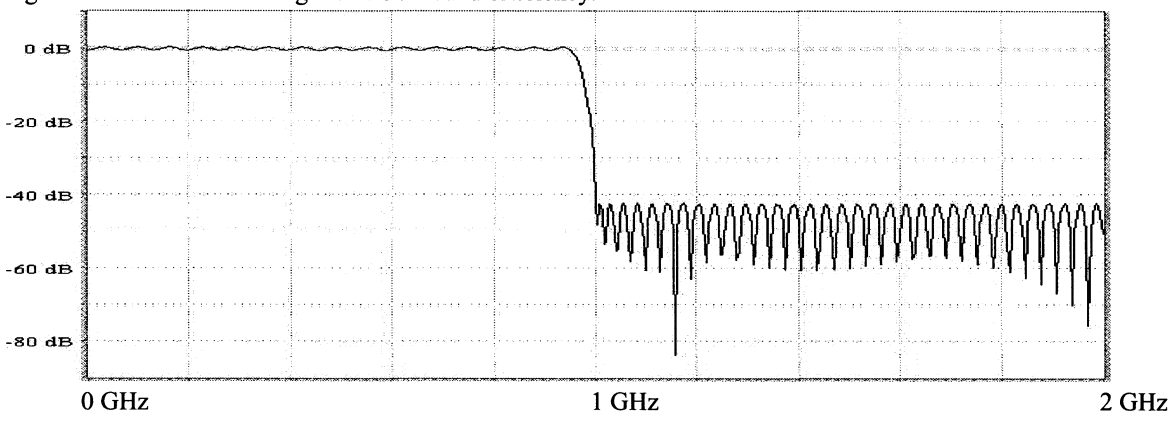

Fig. 1B. 1/2 band filter performance.

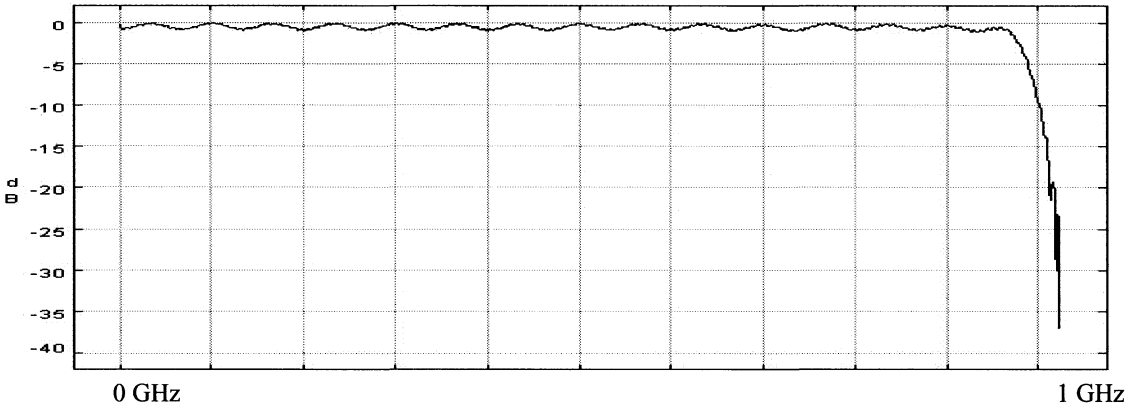

Fig. 2A. 1/2 band filter design with 0.9 band efficiency.

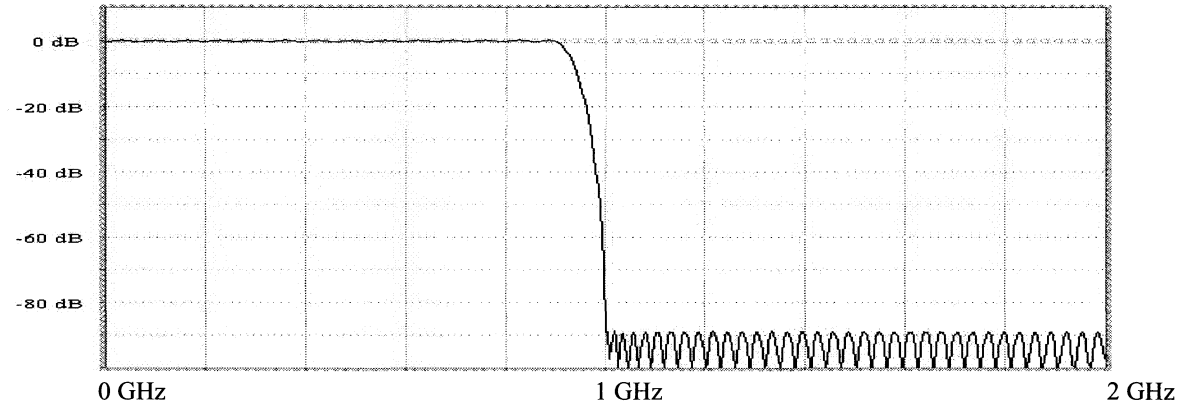

Fig. 2B. 1/2 band filter performance.

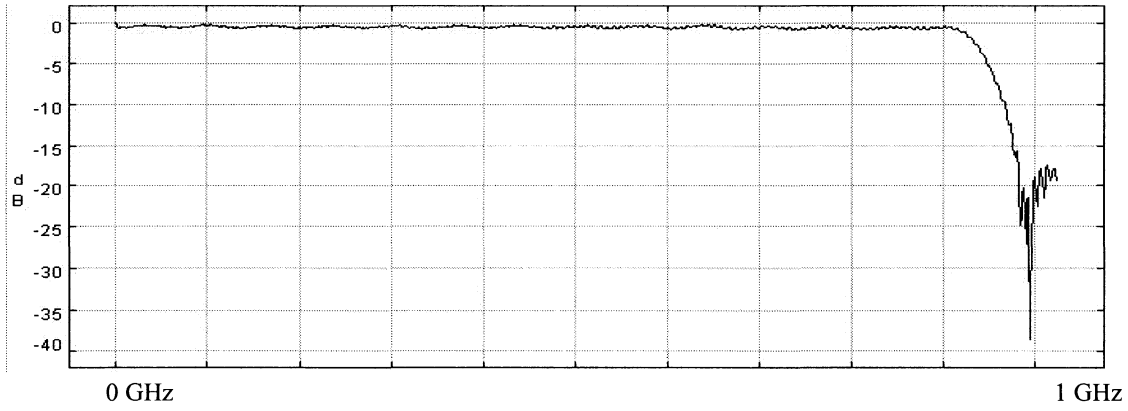

Fig. 3A. 1/2 band filter design with 0.75 band efficiency.

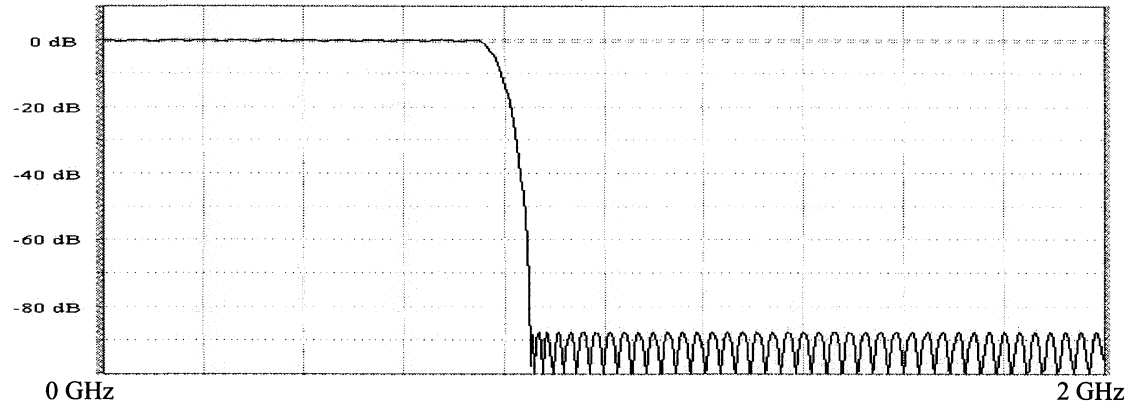

Fig. 3B. 1/2 band filter performance.

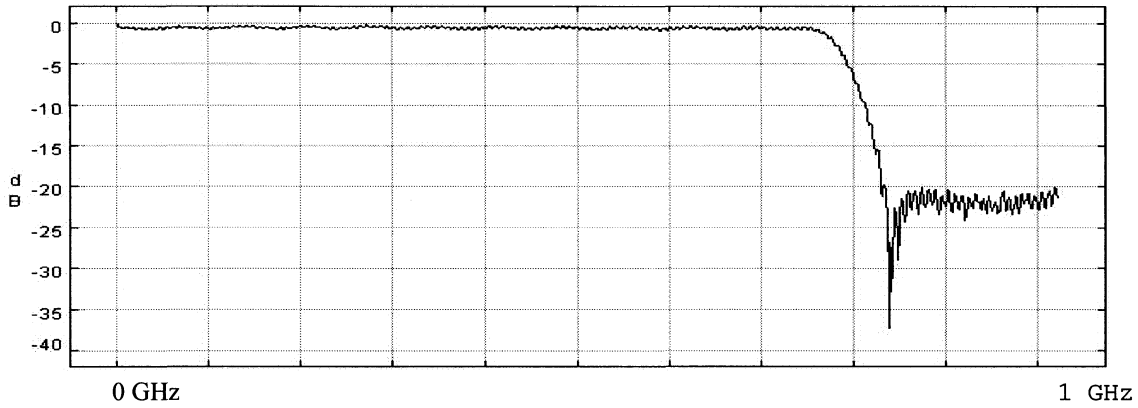

Fig. 4A. 1/2 band filter design (band pass).

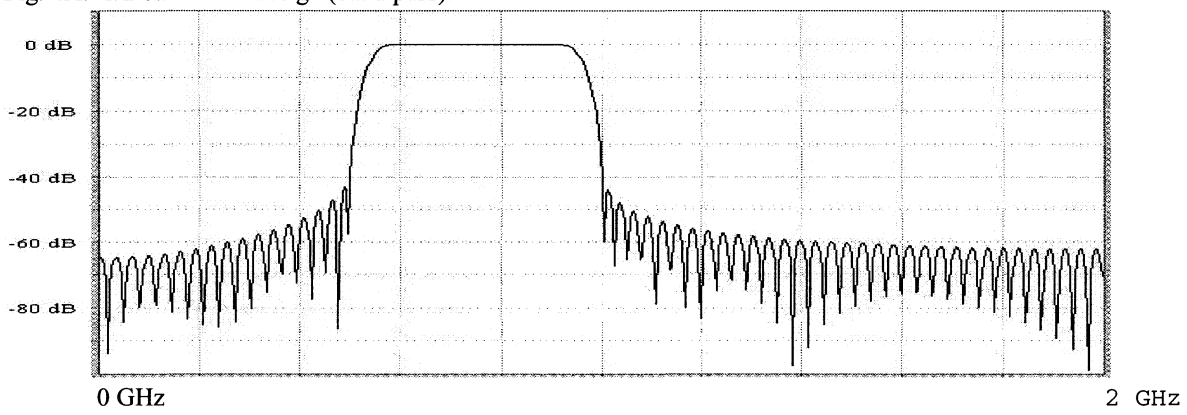

Fig. 4B. Band pass filter performance.

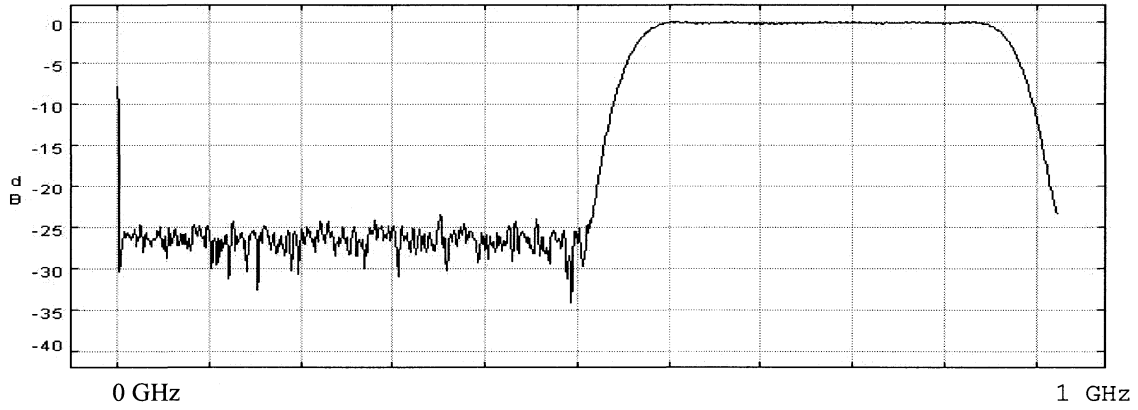

Fig. 5A. 1/4 band filter design with 0.95 band efficiency.

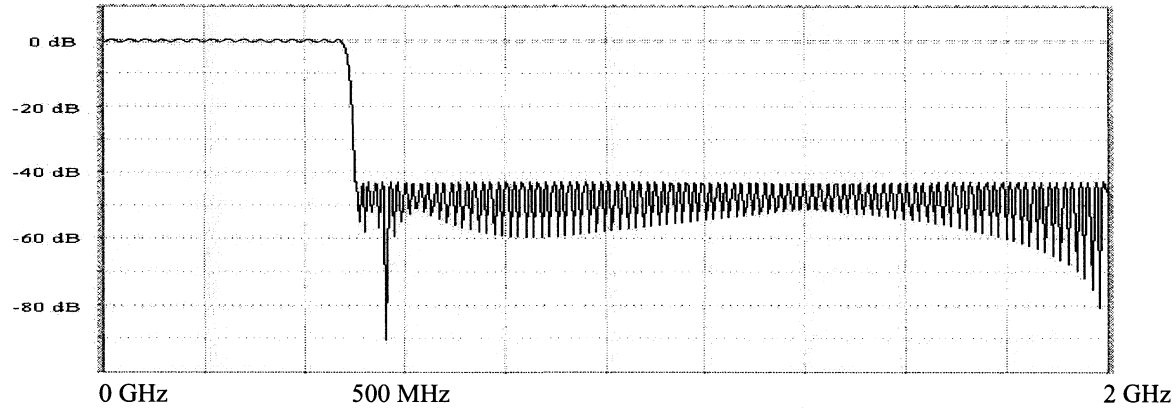

Fig. 5B. 1/4 band filter performance.

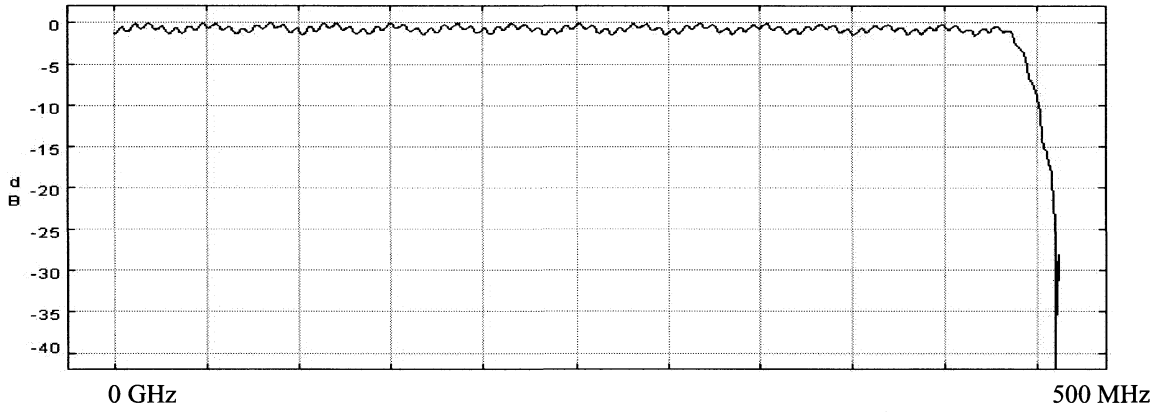

Fig. 6A. 1/4 band filter design with 0.9 band efficiency.

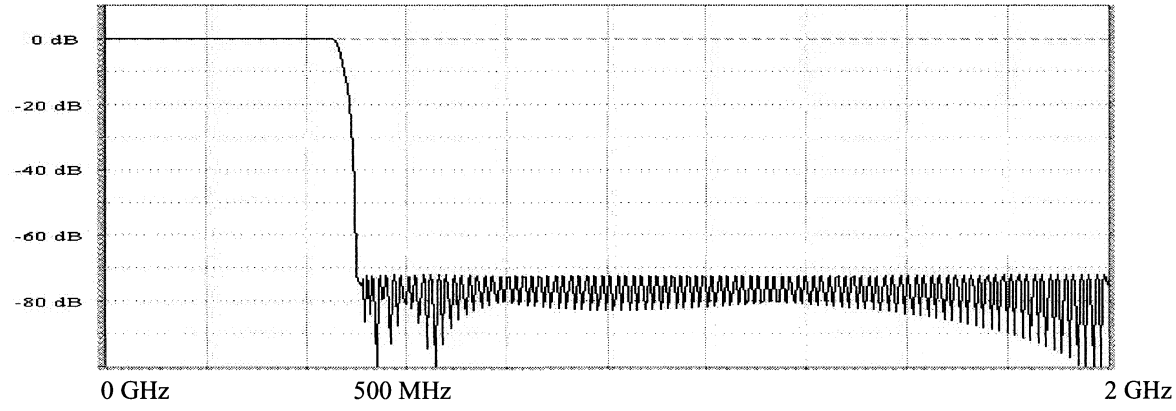

Fig. 6B. 1/4 band filter performance.

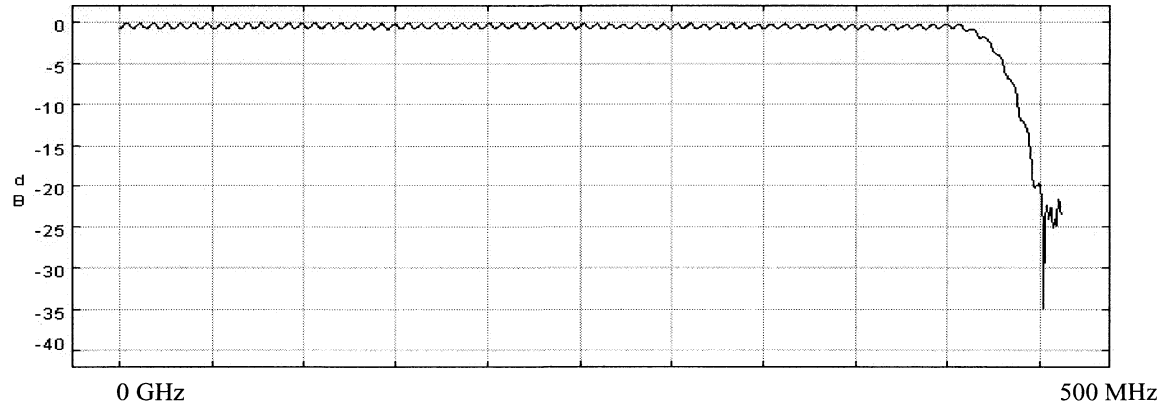

Fig. 7A. 1/4 band filter design with 0.75 band efficiency.

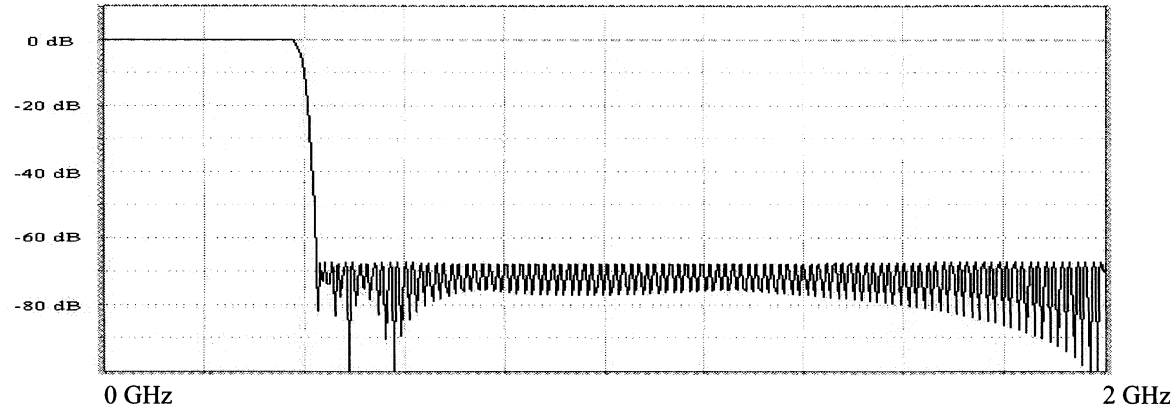

Fig. 7B. 1/4 band filter performance.

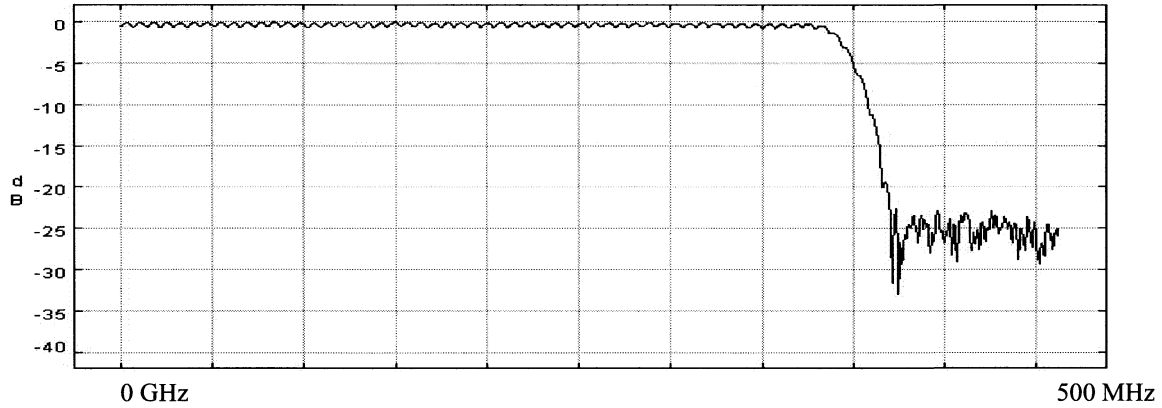

Fig. 8A. 1/4 band filter design (band pass).

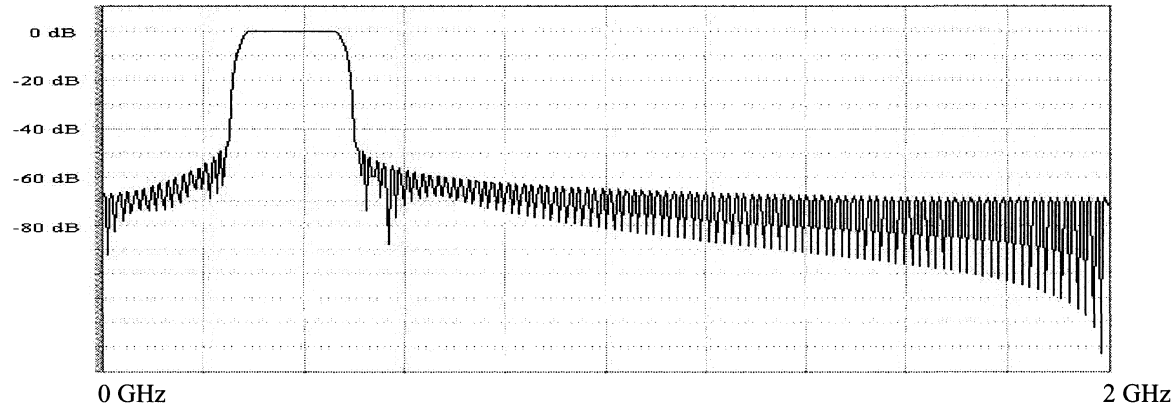

Fig. 8B. Band pass filter performance.

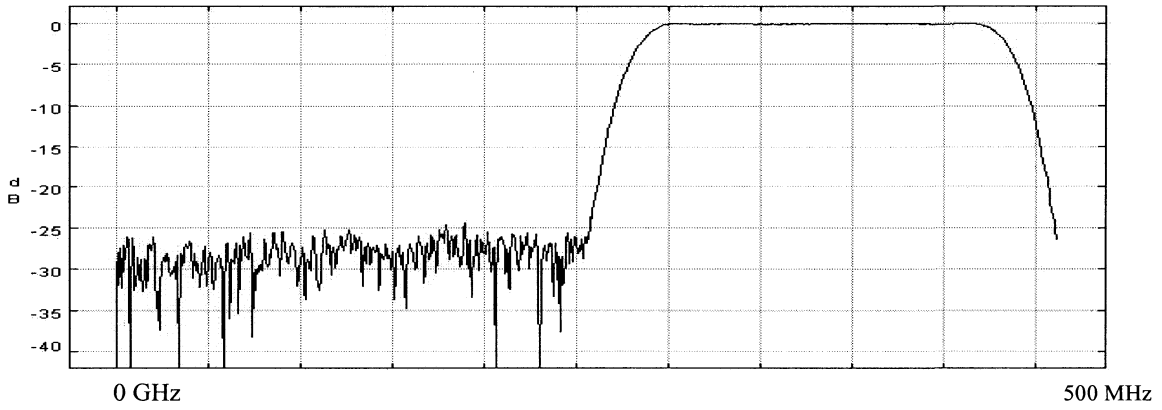

Fig. 9A. 1/8 band filter design with 0.95 band efficiency.

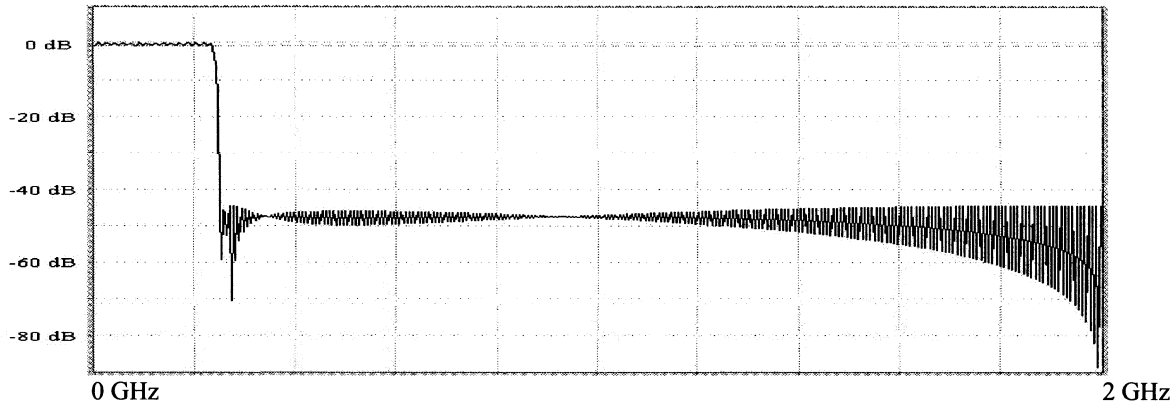

Fig. 9B. 1/8 band filter performance.

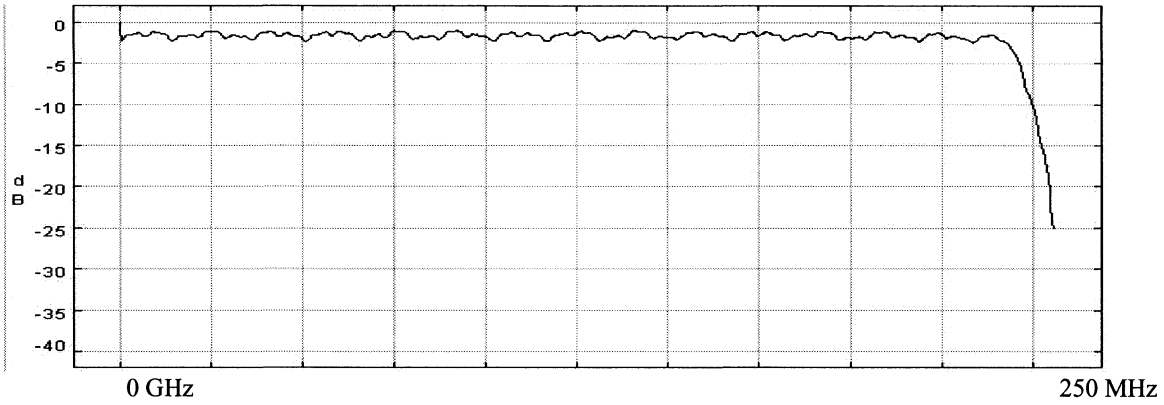

Fig. 10A. 1/8 band filter design with 0.9 band efficiency.

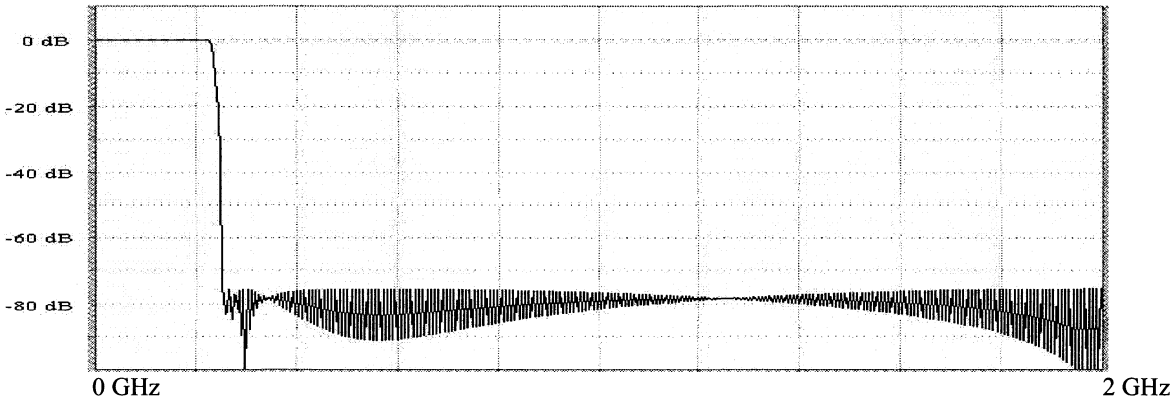

Fig. 10B. 1/8 band filter performance.

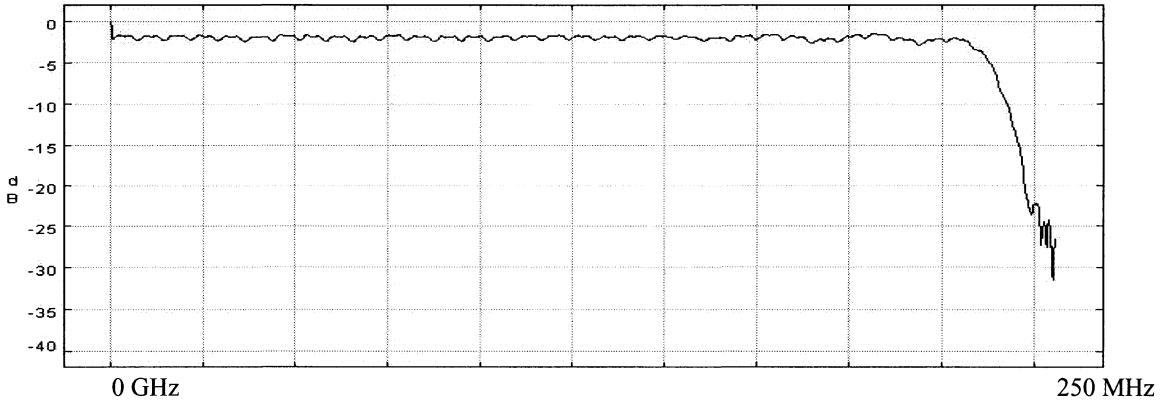

Fig. 11A. 1/8 band filter design with 0.75 band efficiency.

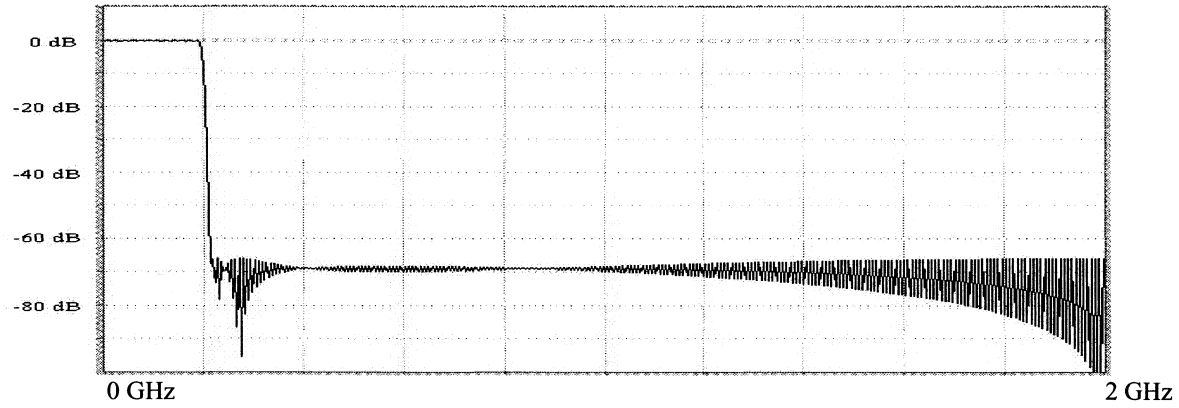

Fig. 11B. 1/8 band filter performance.

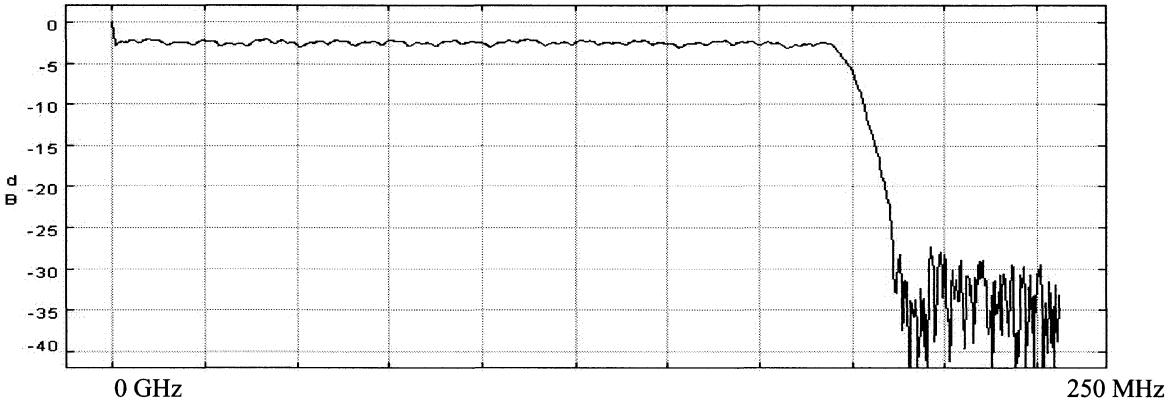

Fig. 12A. 1/8 band filter design (band pass).

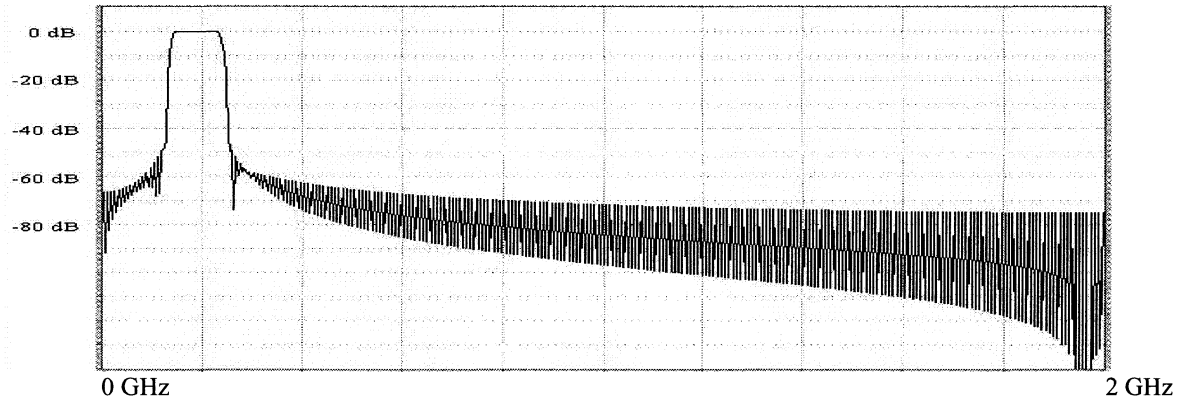

Fig. 12B. Band pass filter performance.

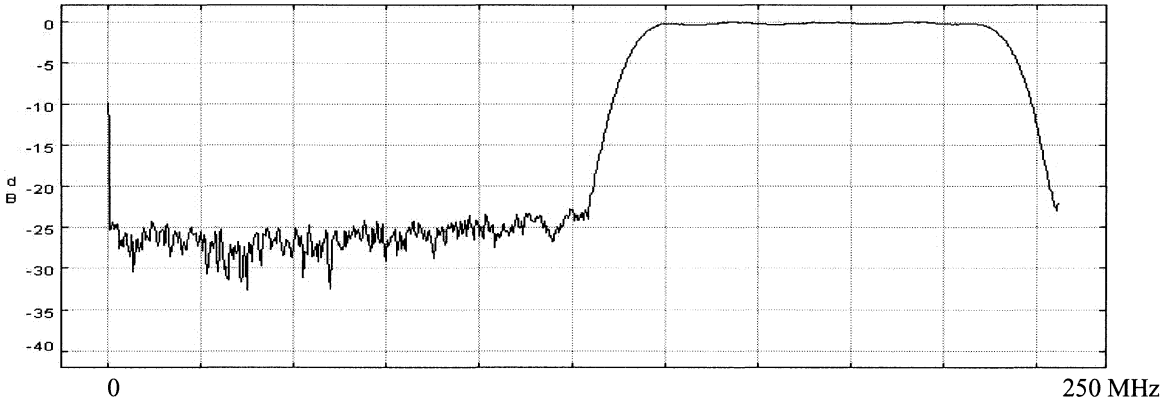

Fig. 13A. 1/16 band filter design with 0.95 band efficiency.

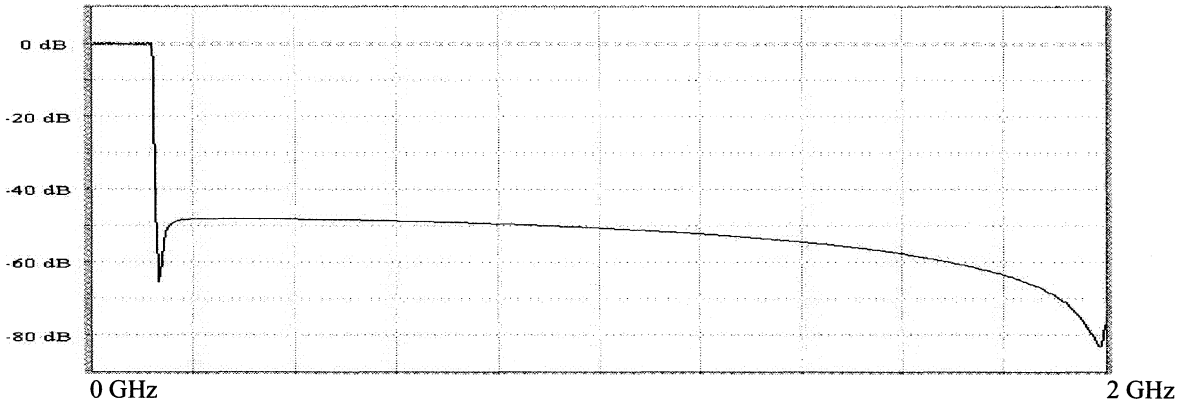

Fig. 13B. 1/16 band filter performance.

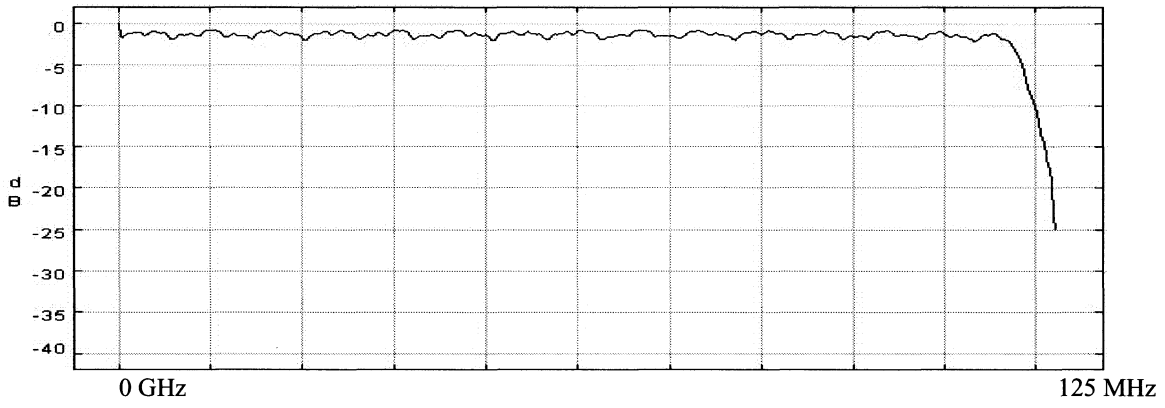

Fig. 14A. 1/16 band filter design with 0.9 band efficiency.

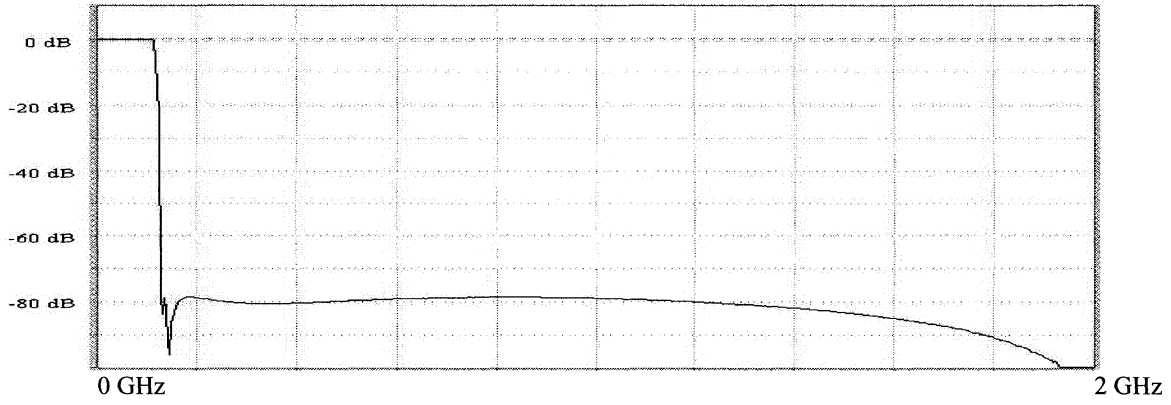

Fig. 14B. 1/16 band filter performance.

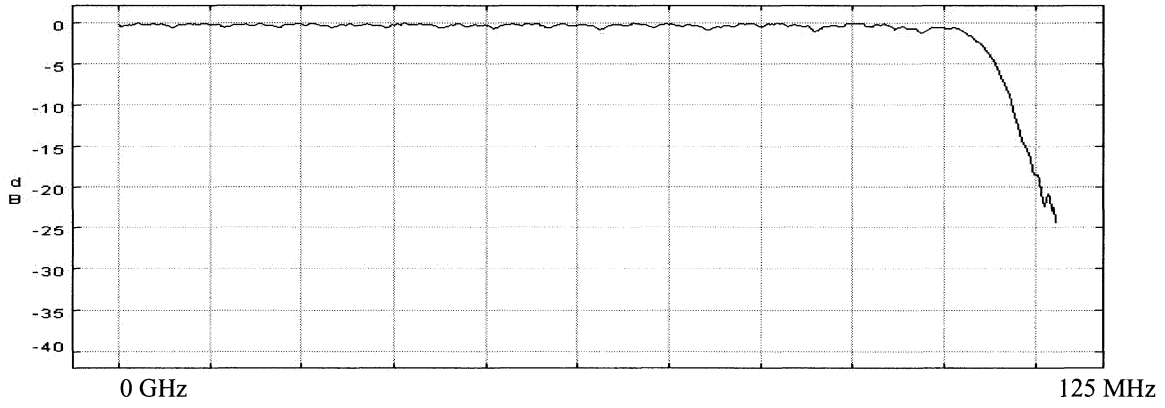

Fig. 15A. 1/16 band filter design with 0.75 band efficiency.

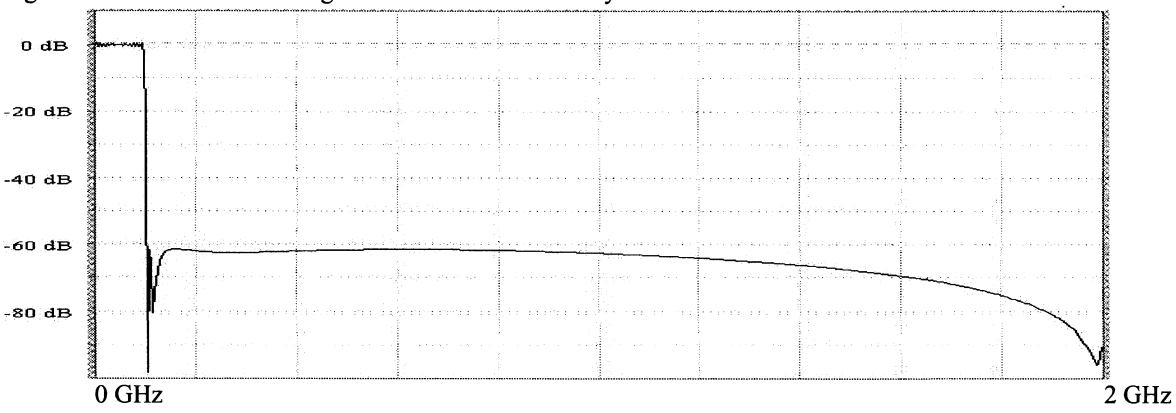

Fig. 15B. 1/16 band filter performance.

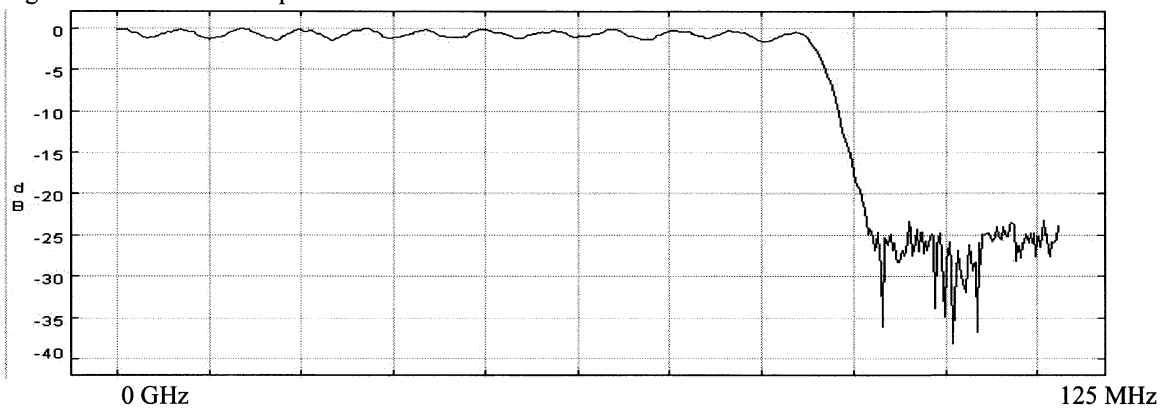

Fig. 16A. 1/16 band filter design (band pass).

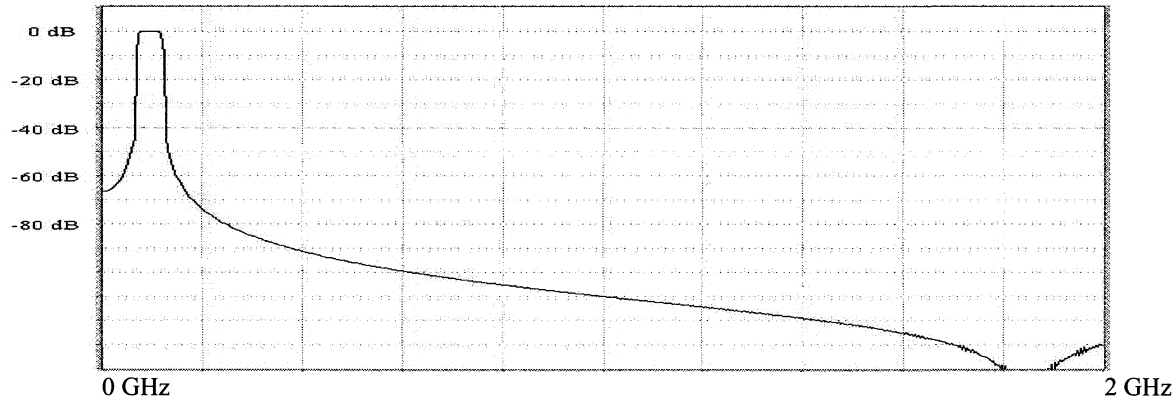

Fig. 16B. Band pass filter performance.

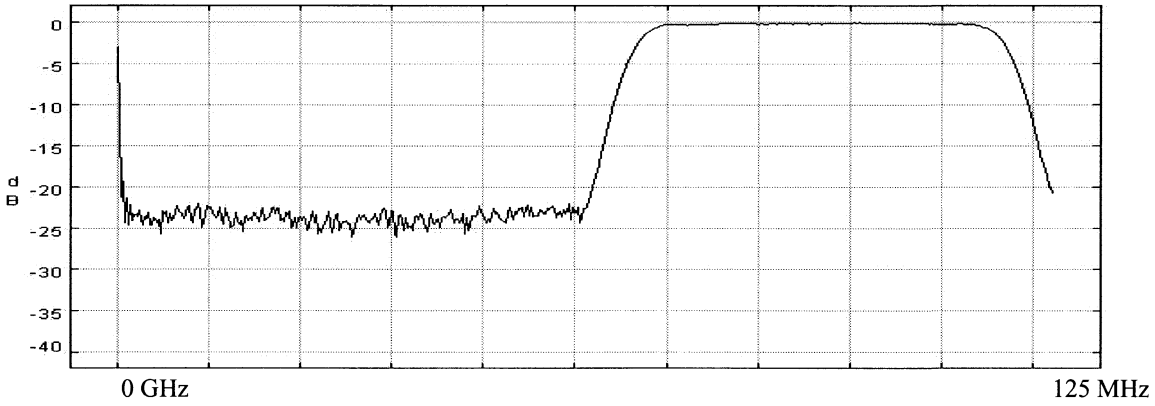

Fig. 17A. 1/32 band filter design with 0.95 band efficiency.

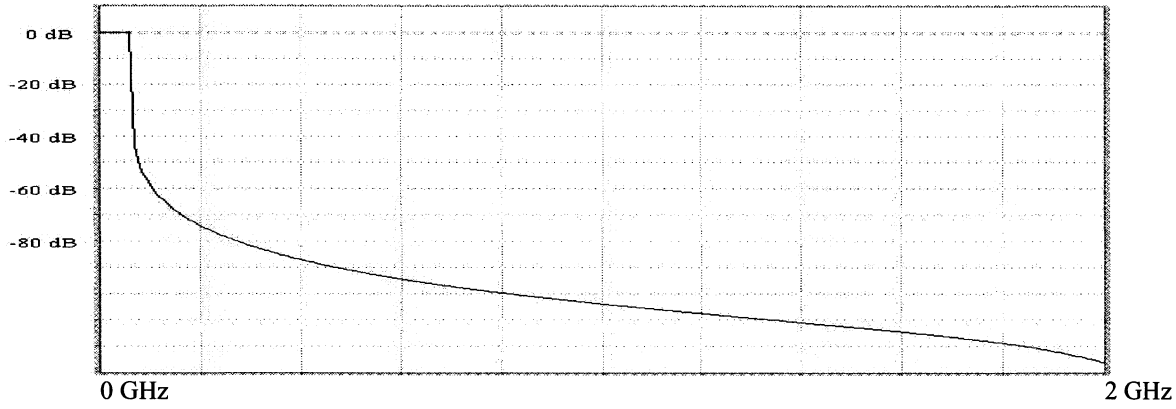

Fig. 17B. 1/32 band filter performance.

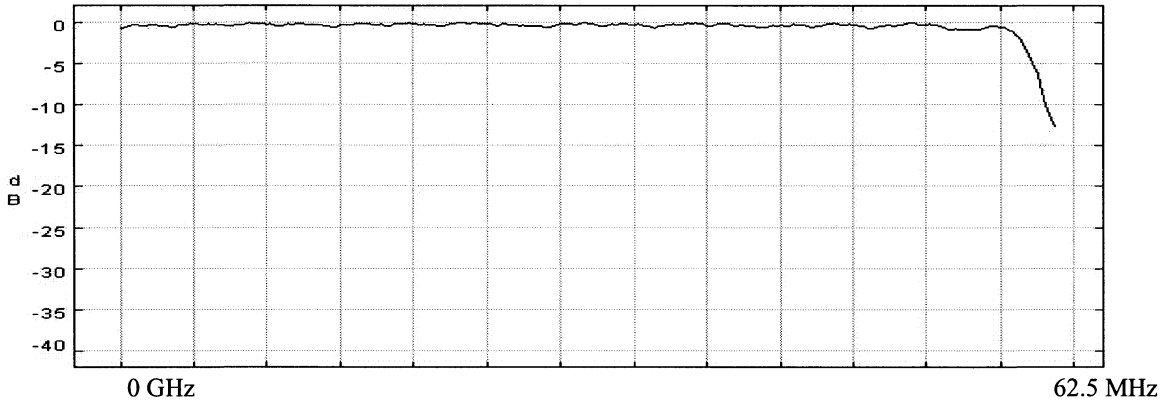

Fig. 18A. 1/32 band filter design with 0.9 band efficiency.

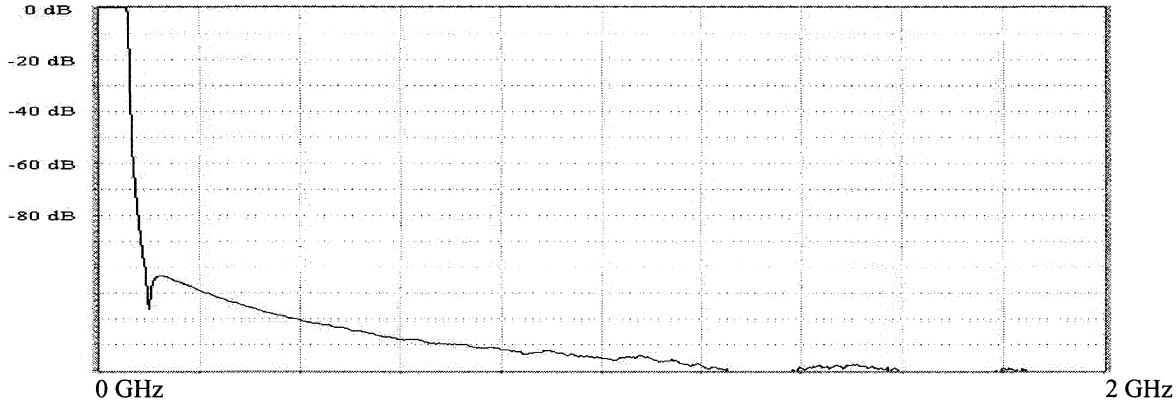

Fig. 18B. 1/32 band filter performance.

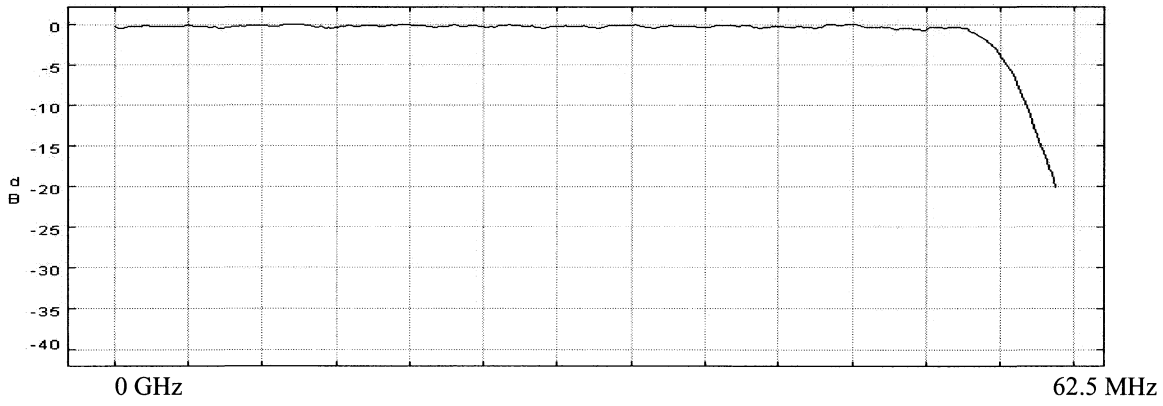

Fig. 19A. 1/32 band filter design with 0.75 band efficiency.

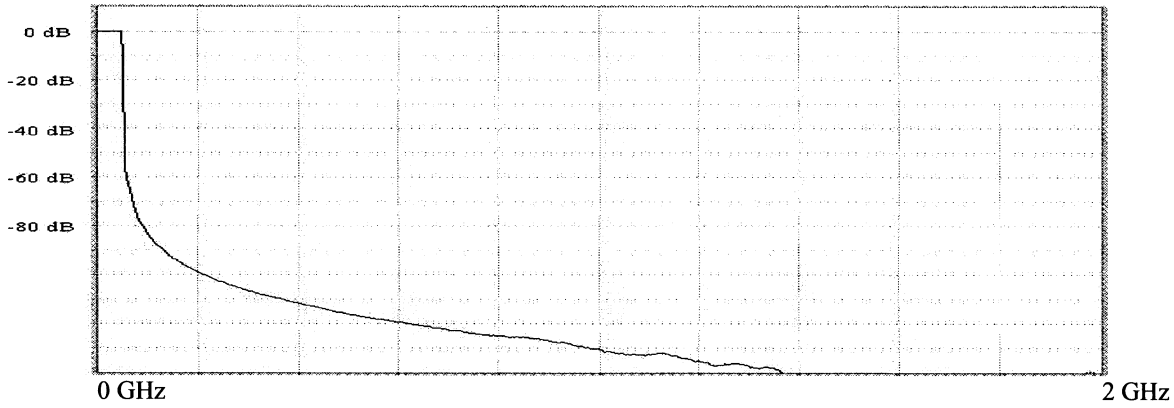

Fig. 19B. 1/32 band filter performance.

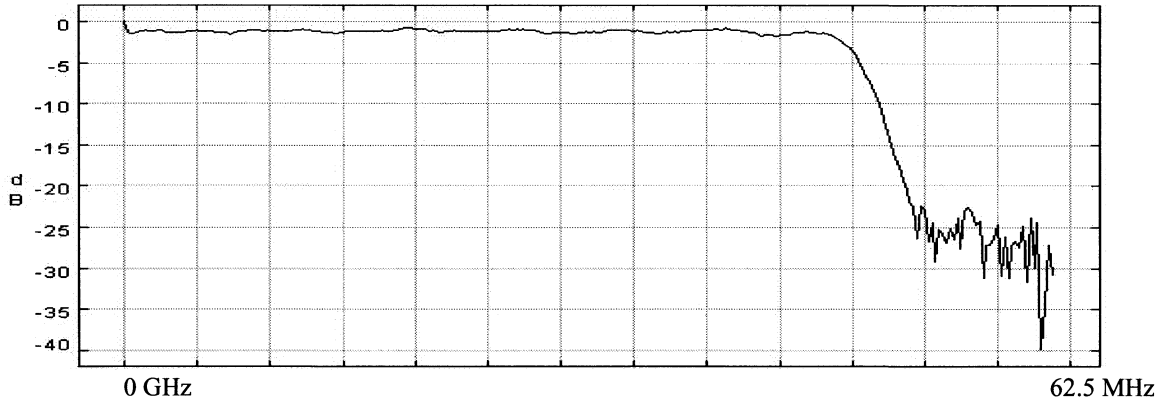

Fig. 20A. 1/32 band filter design (band pass).

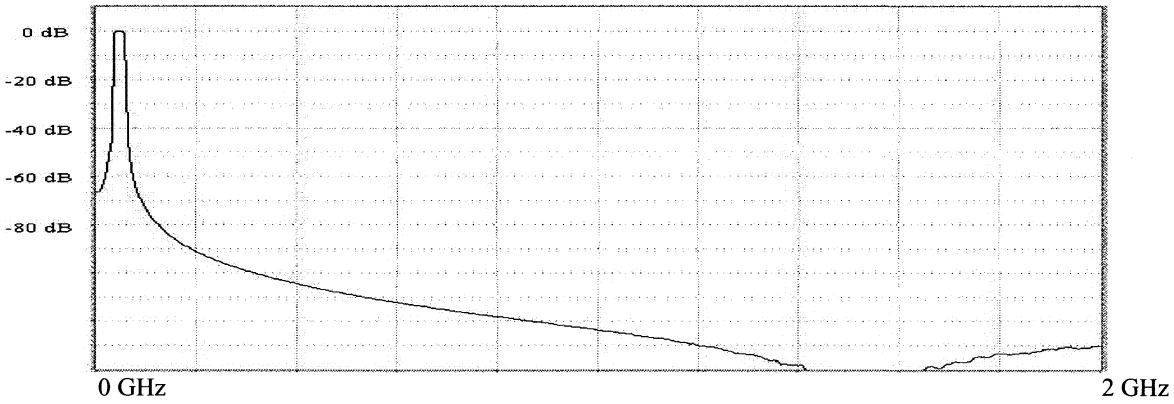

Fig. 20B. Band pass filter performance.

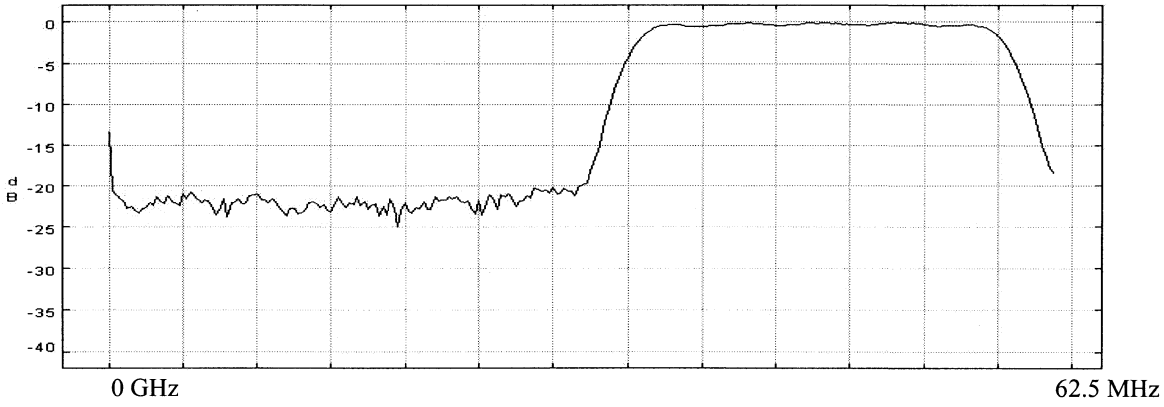

Figure 22 (signal-reference)/reference result of 1/2 band filter with 4-bit sampling.

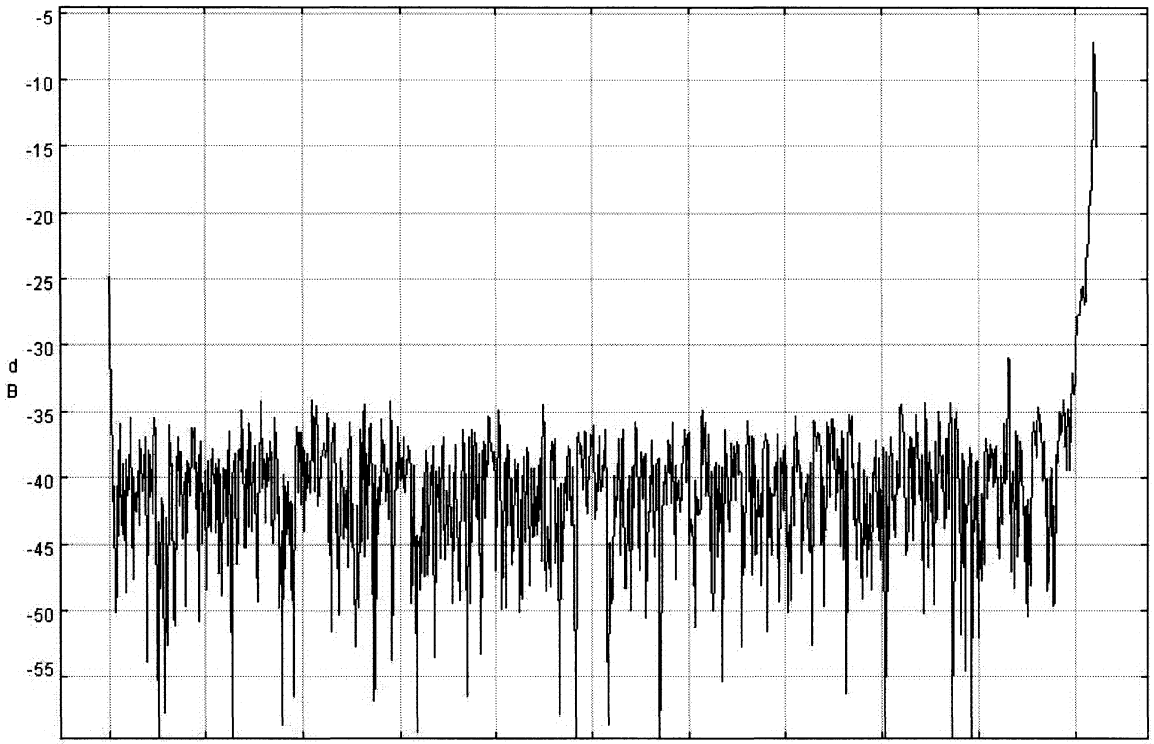

Figure 23 (signal-reference)/reference result of 1/2 band filter with 3-bit sampling.

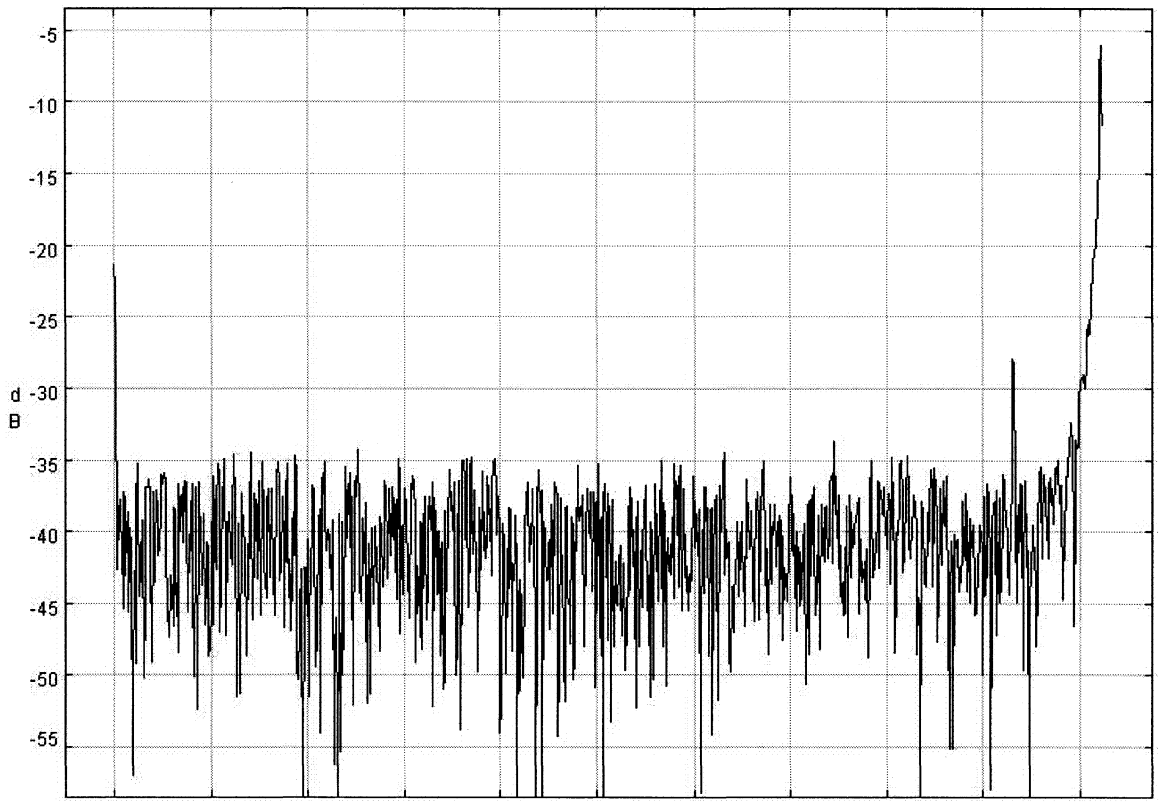

Figure 24 (signal-reference)/reference result of 1/4 band filter with 4-bit sampling.

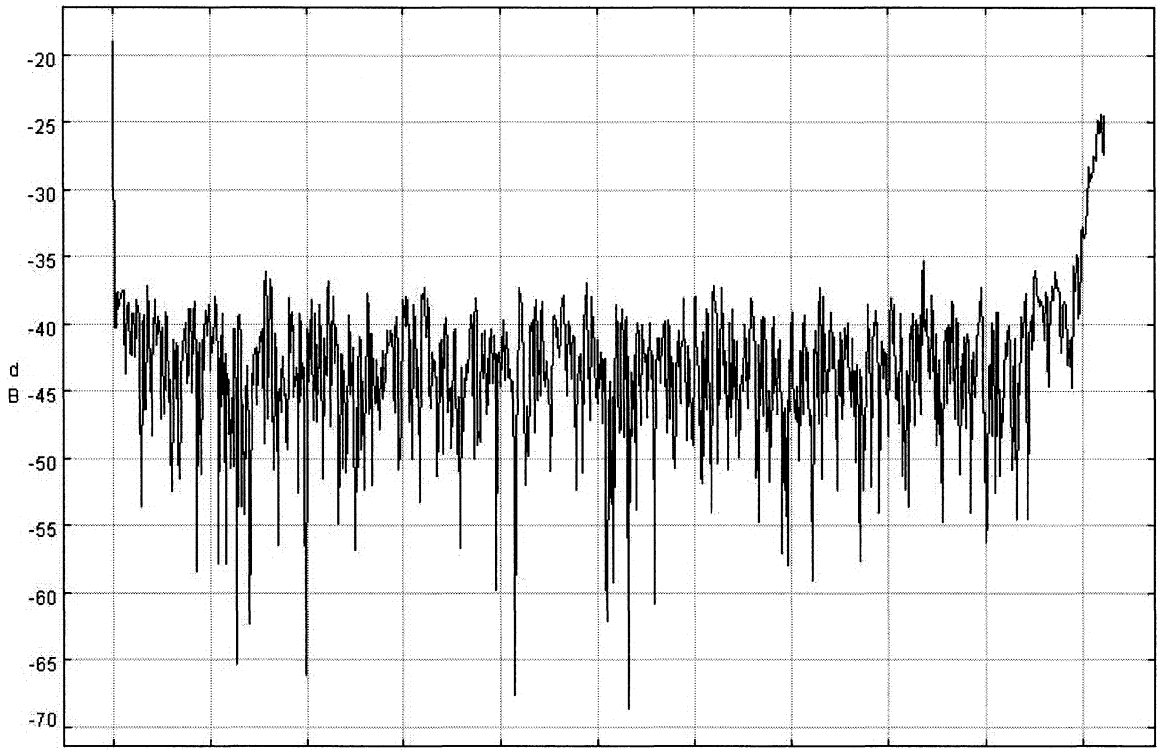

Figure 25 (signal-reference)/reference result of 1/4 band filter with 3-bit sampling.

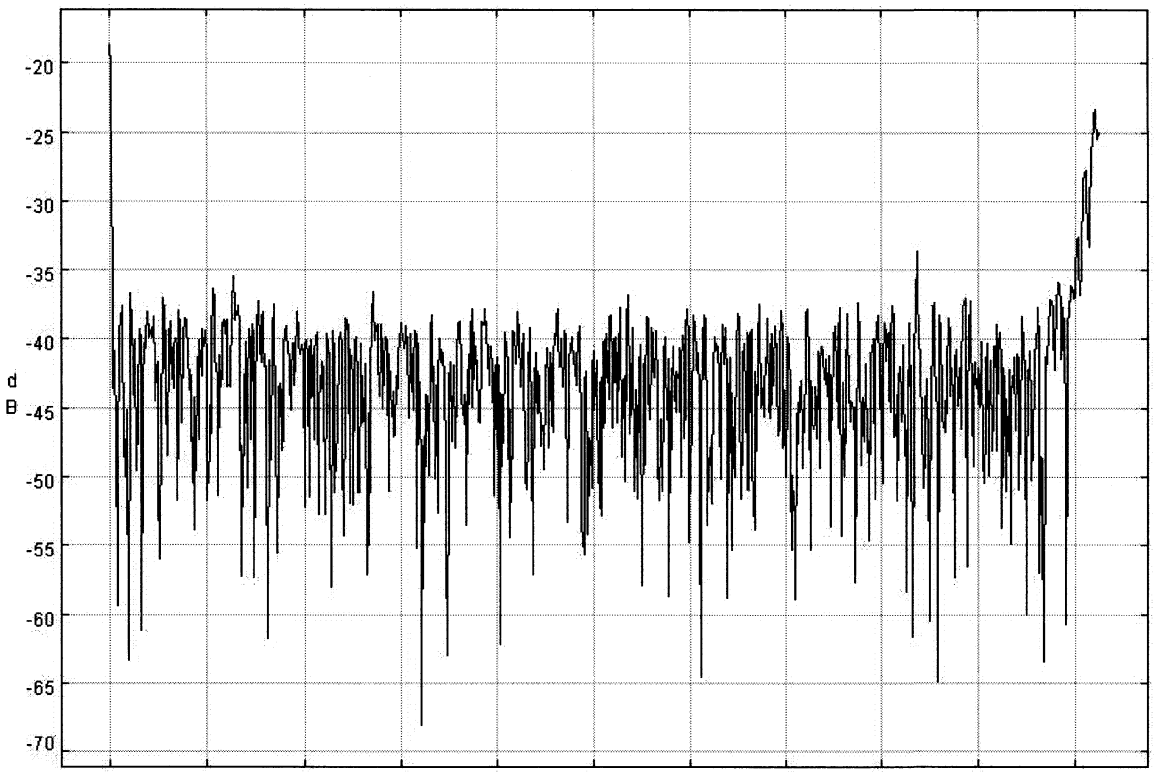

Figure 26 (signal-reference)/reference result of 1/8 band filter with 4-bit sampling.