

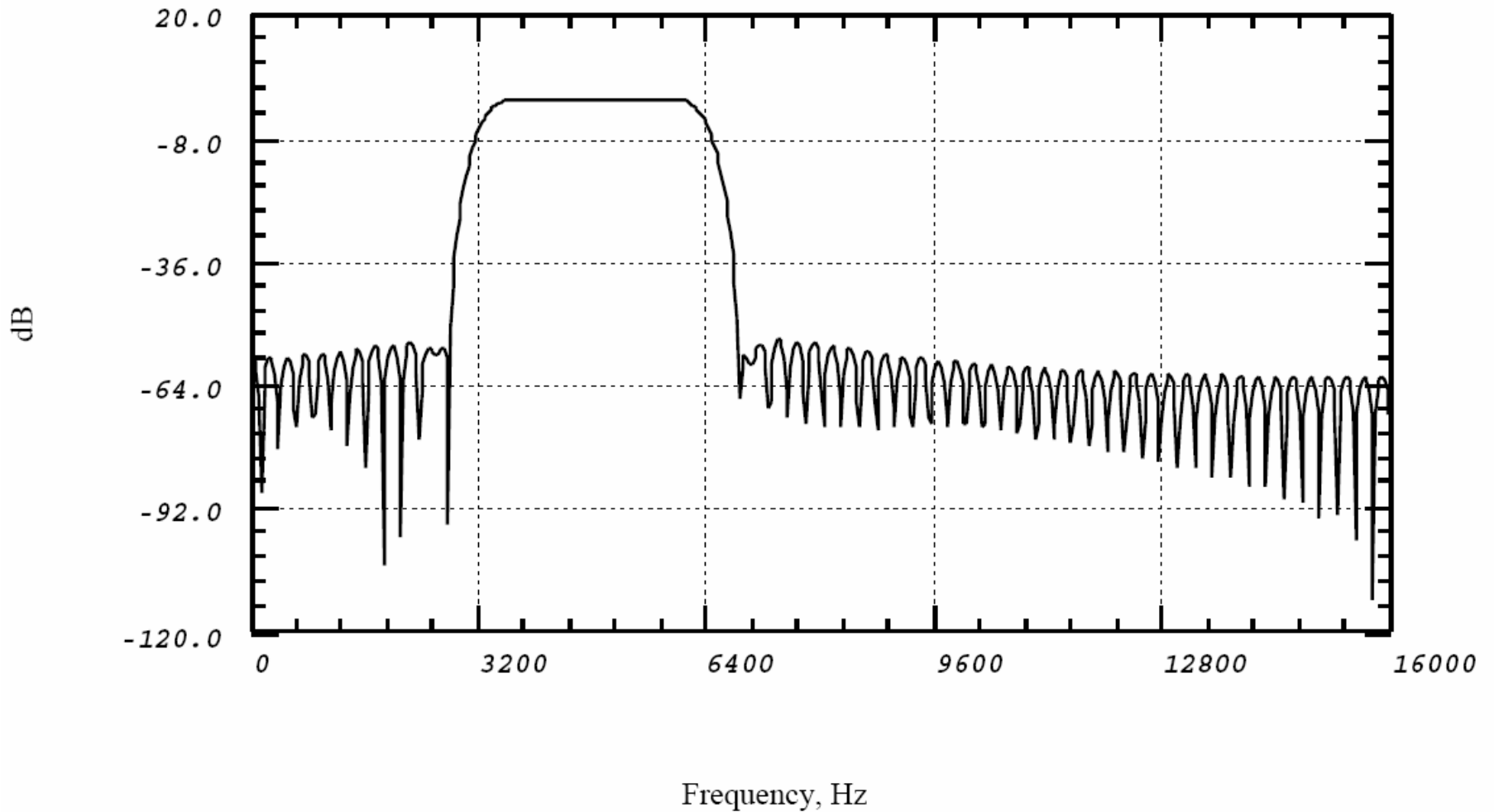
Variable Precision Fixed Point Digital Filter Modeling

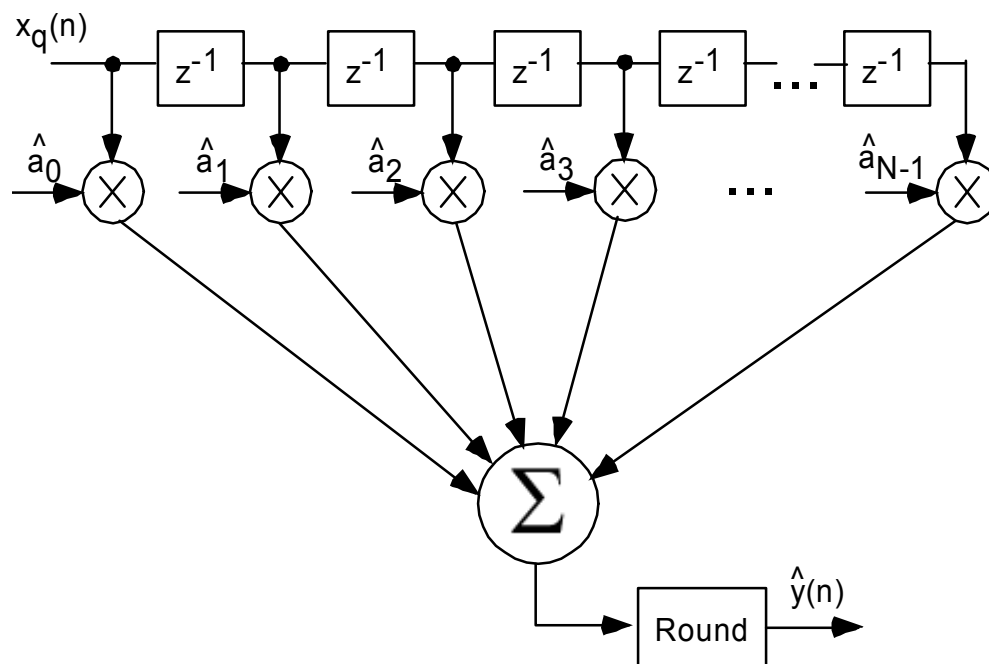
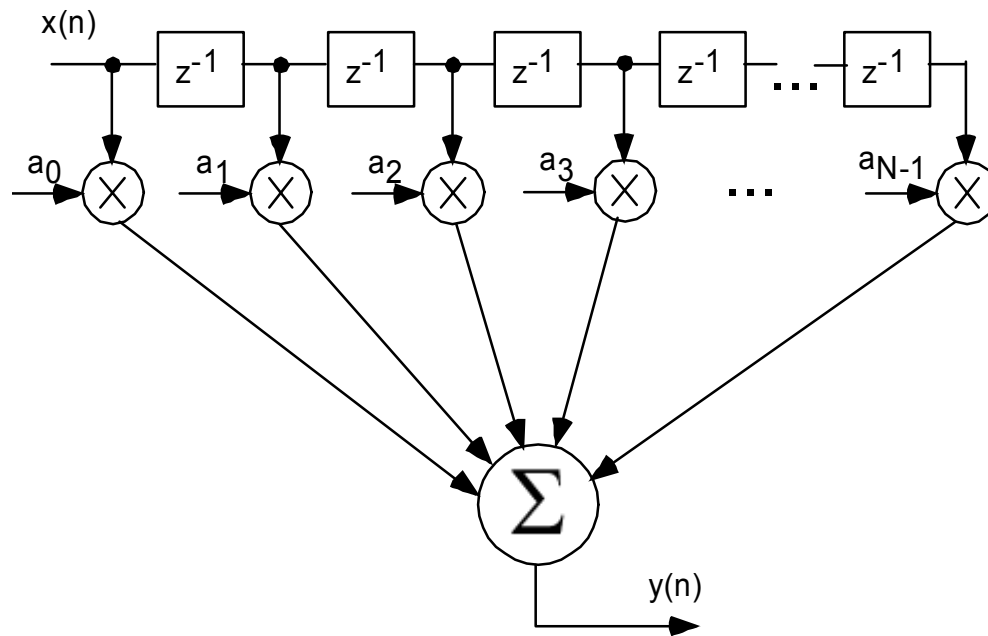


Topics

- FIR Filters
- Cascade Form IIR Filters
- Normalized Lattice Filters
- Variable Precision Fixed Point Building Blocks

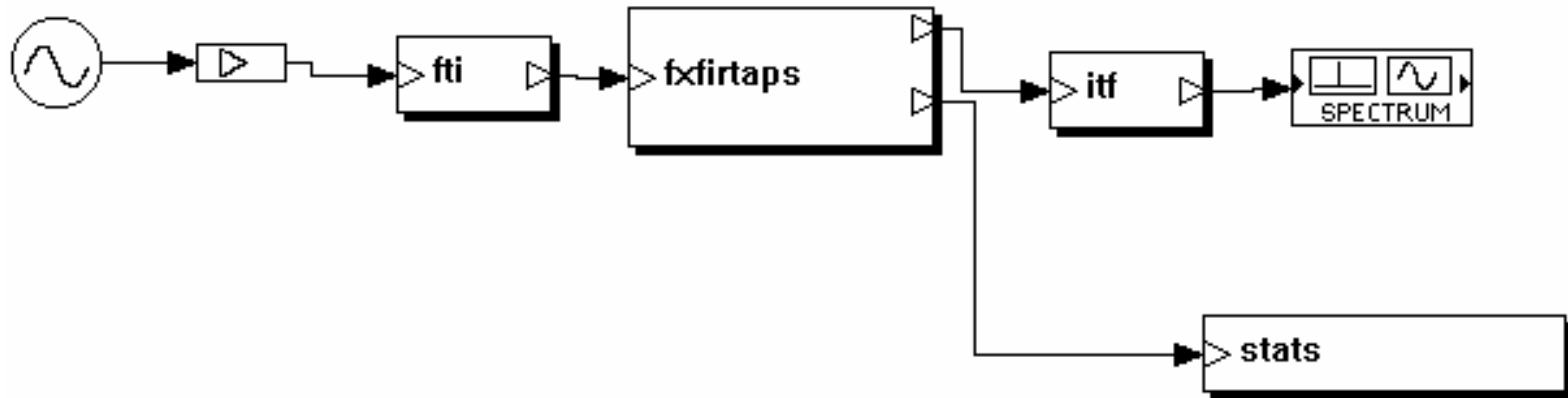
Band Pass FIR Filter





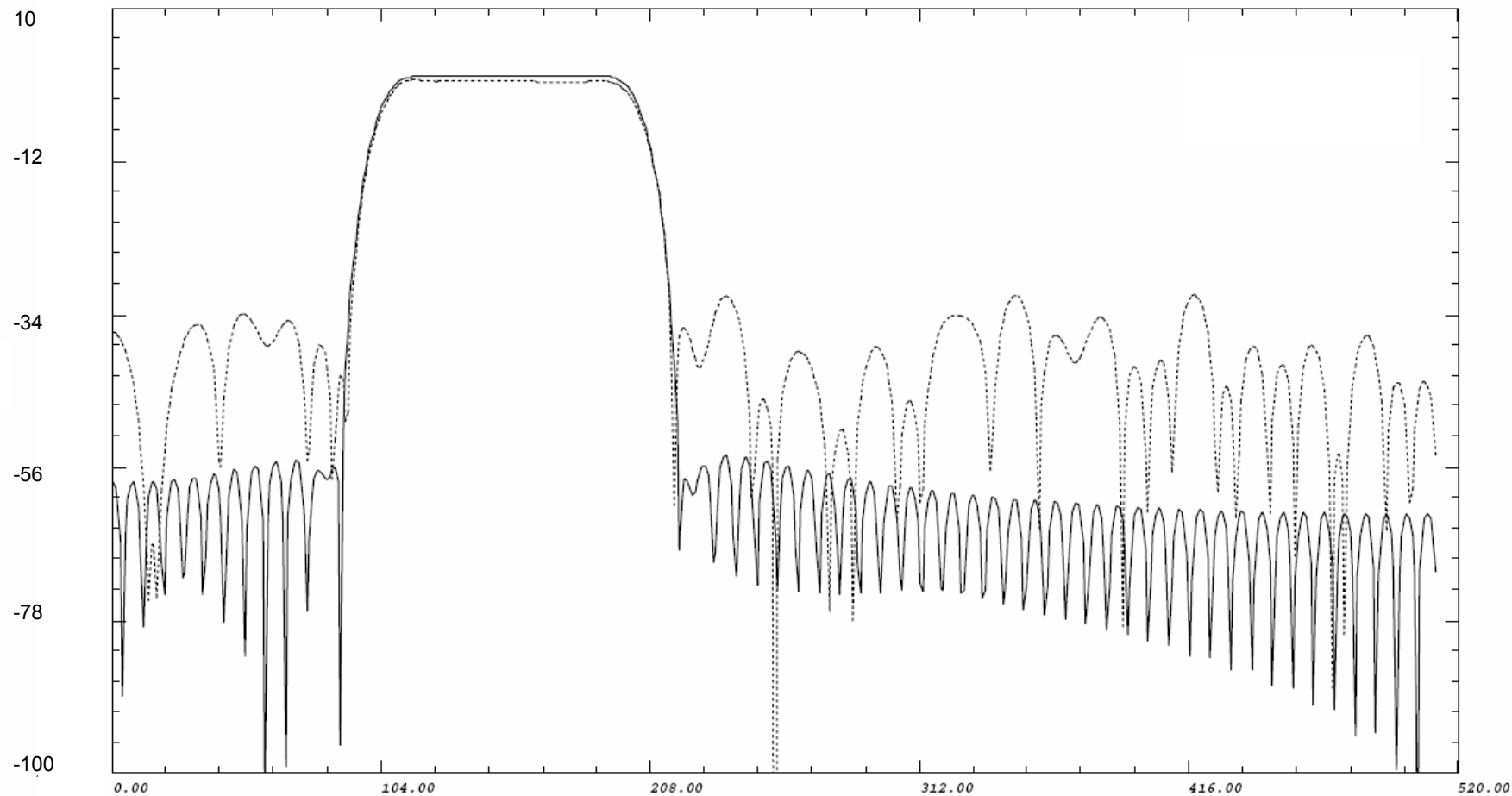
fxfirtaps

Variable Precision Fixed Point FIR Filter Block



Band Pass FIR Filter 8 bit Fraction Fixed Point versus Floating Point

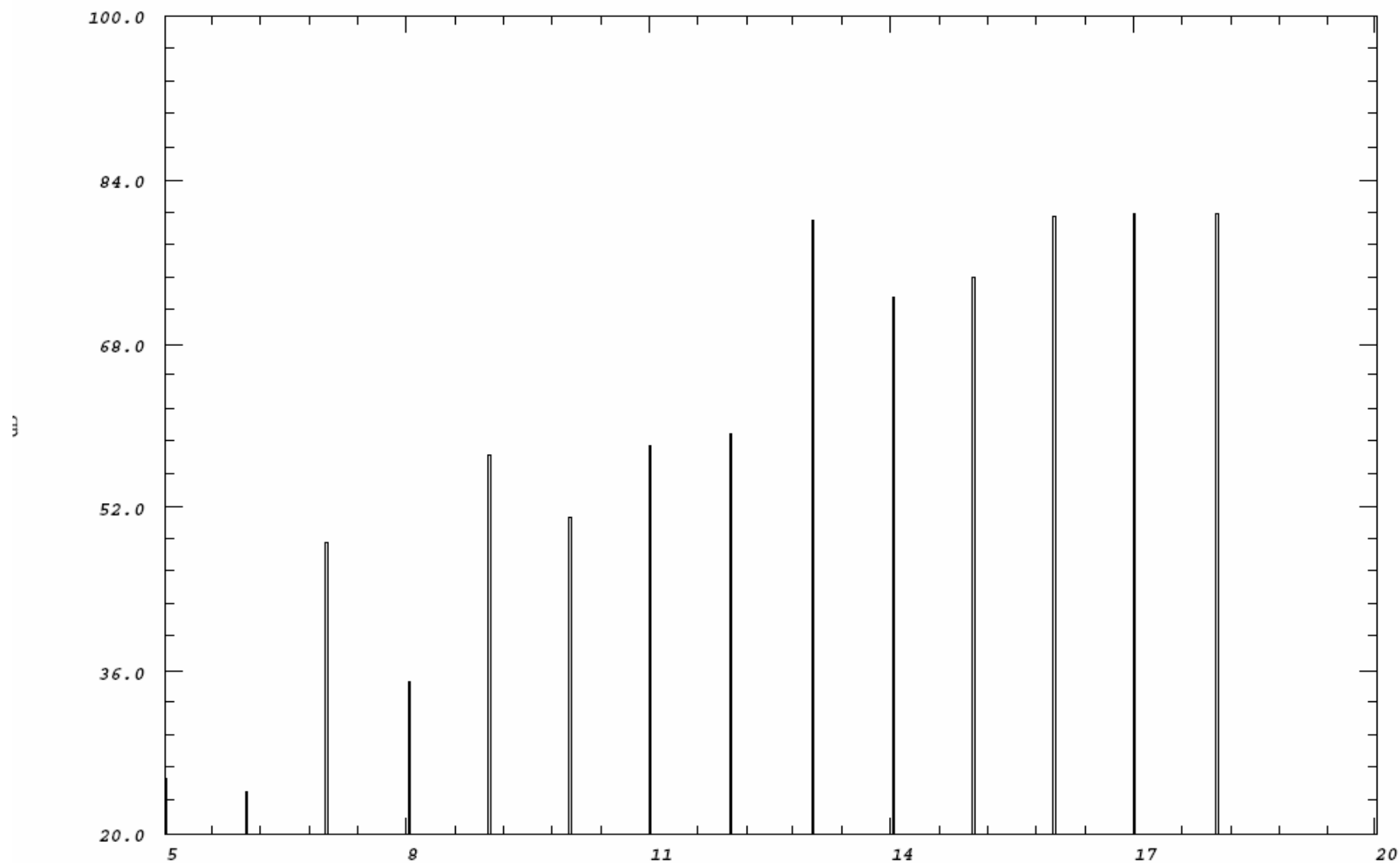
dB



Frequency, Bin

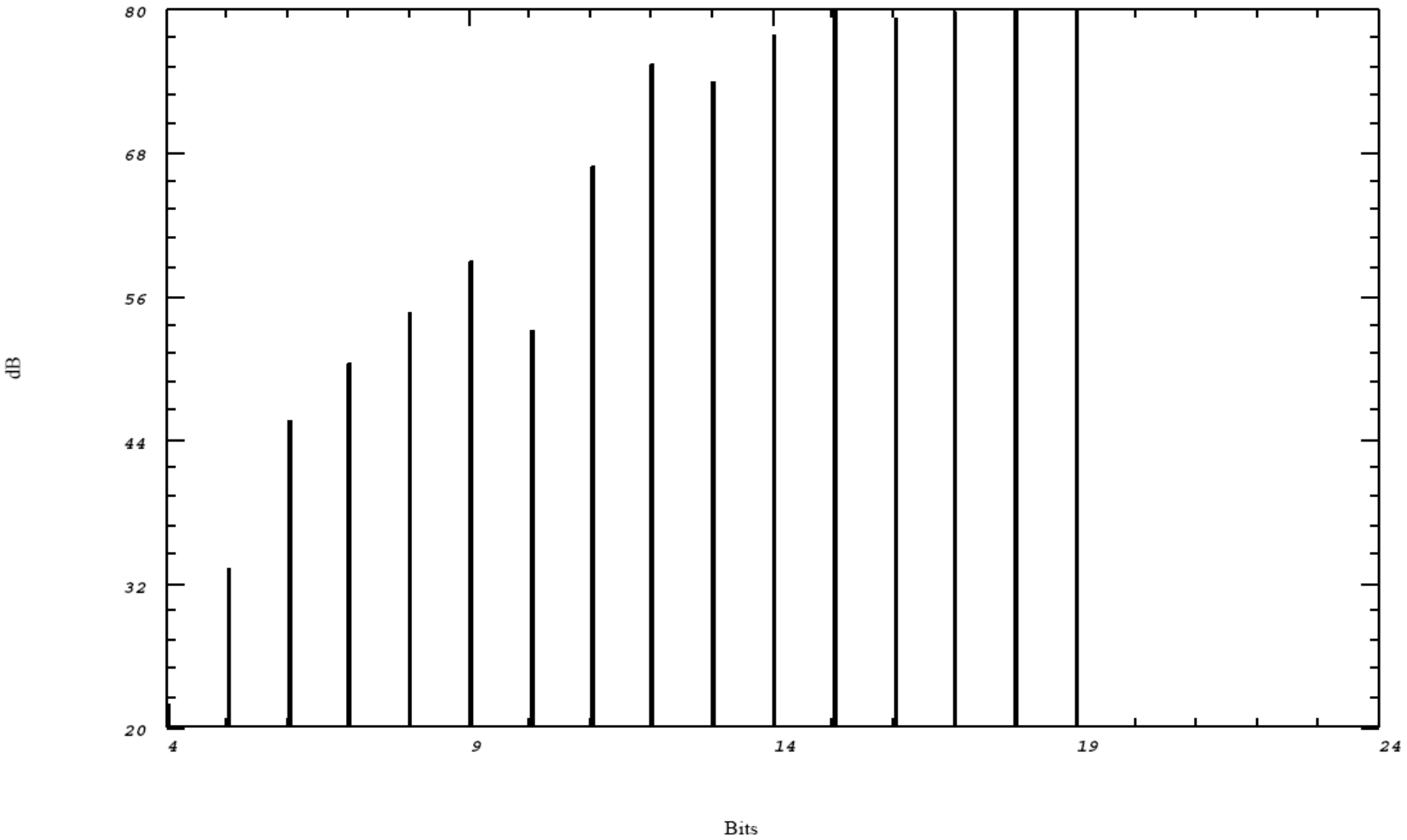
Fixed Point FIR Filter Stop Band Signal to Error Ratio

Frequency 1005 Hz Stop Band



Fixed Point Band Pass FIR Filter Pass Band Signal to Error

Frequency 5005 Hz Pass Band

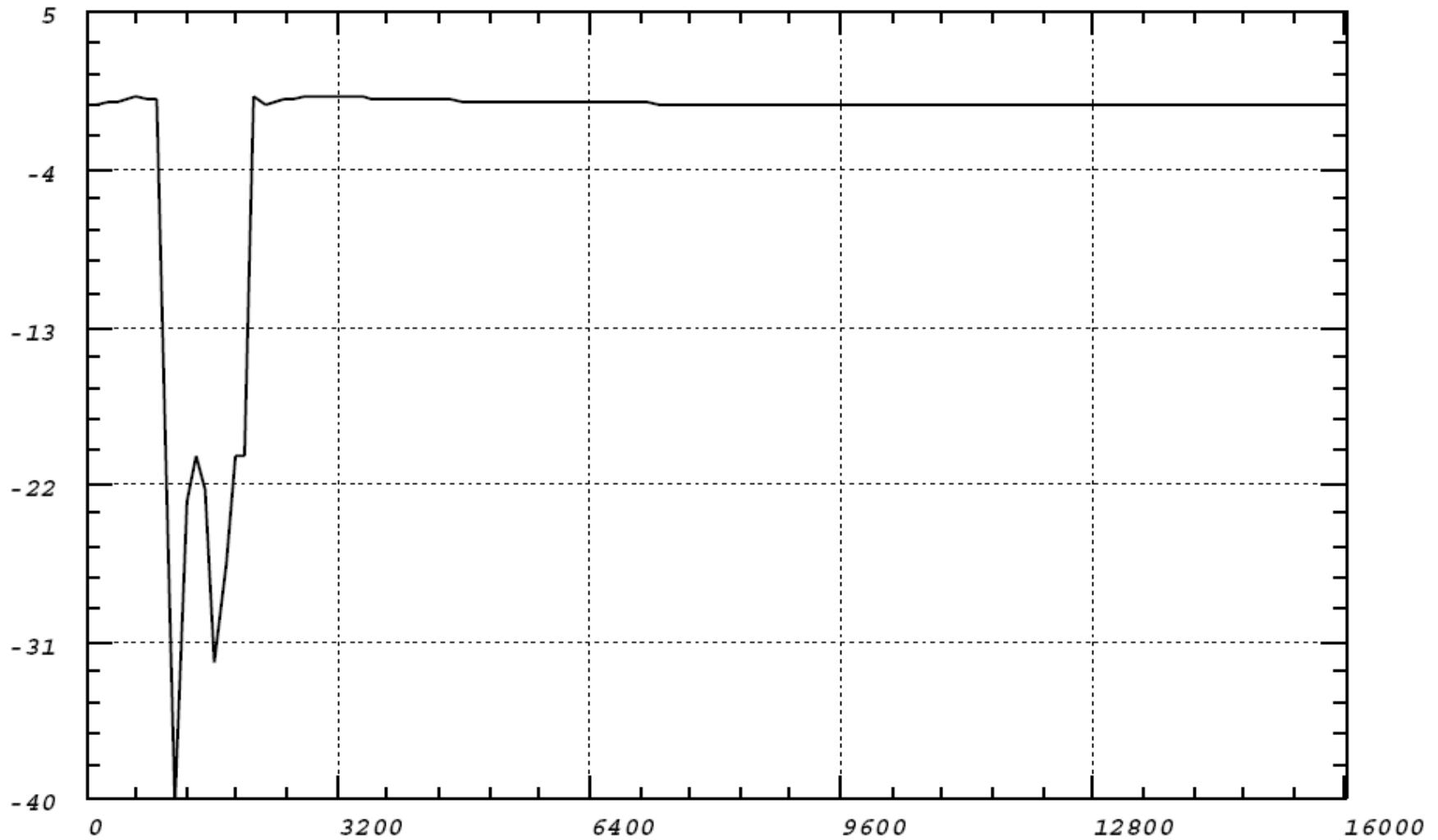


Fixed Point Cascade Form IIR Filter

Band Stop IIR Filter

Magnitude Response

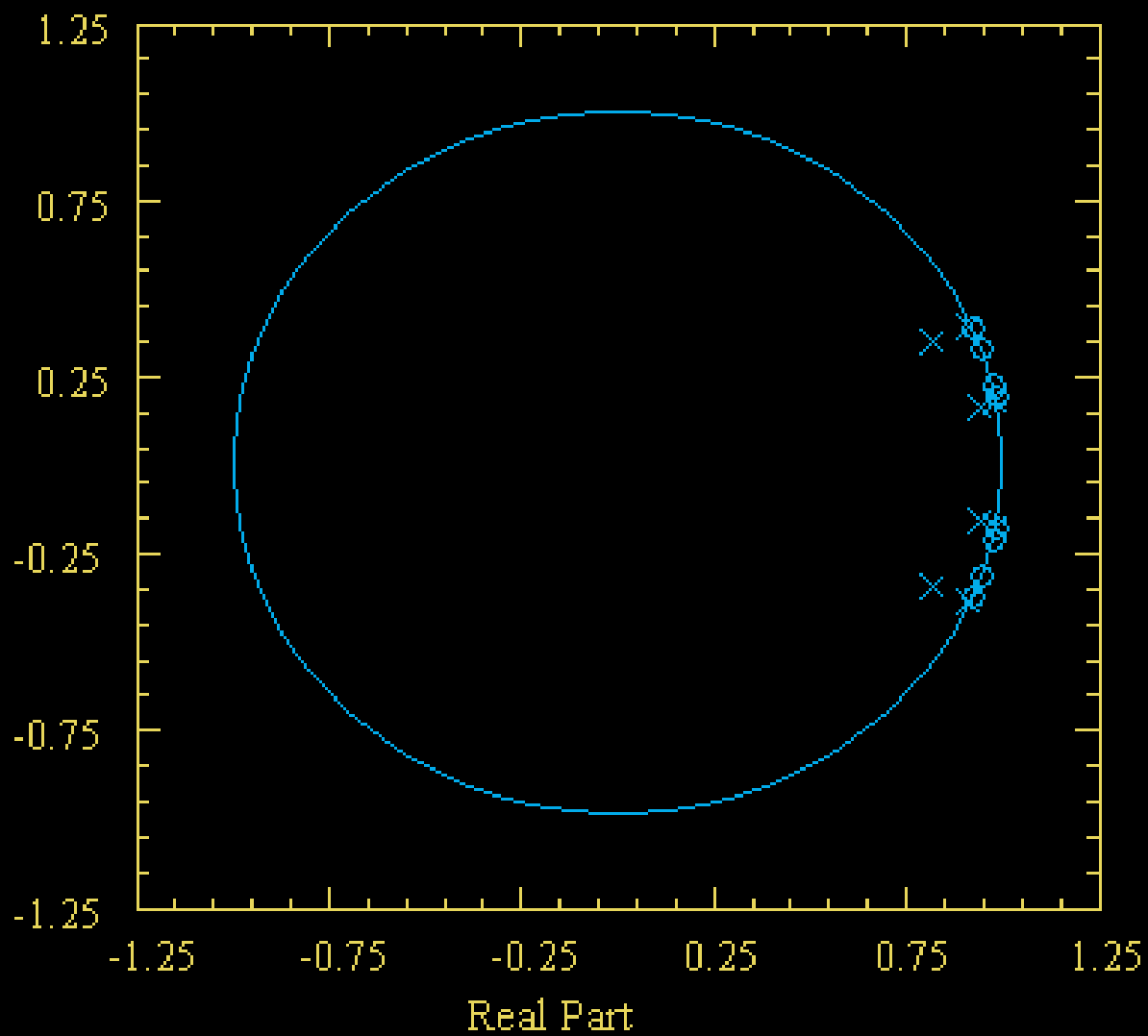
dB

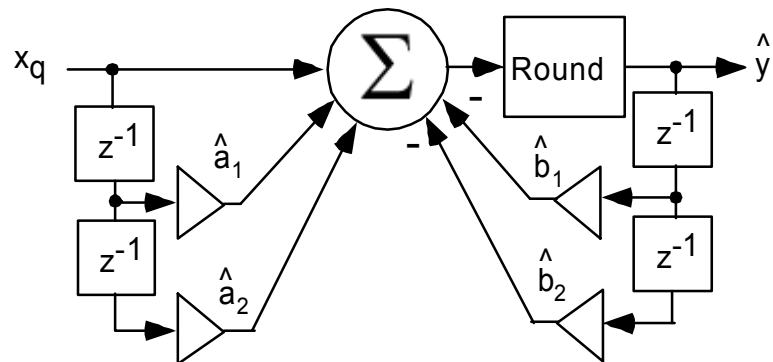
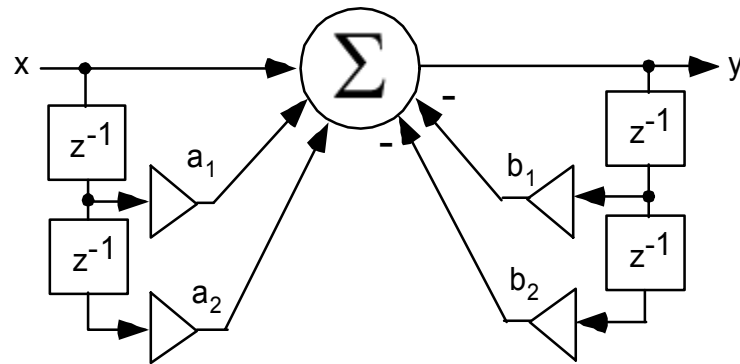


Frequency

bandstop.pz

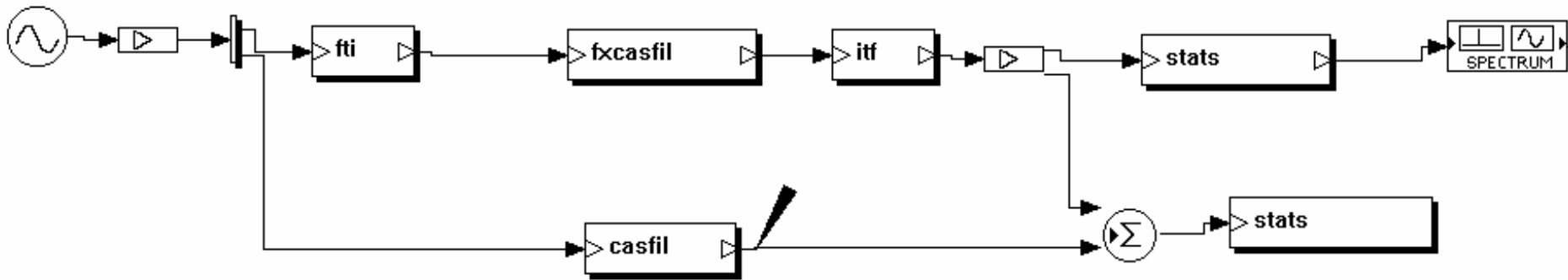
Imag. Part





fxcasfil

Variable Precision Fixed Point Cascade Form IIR Filter Block

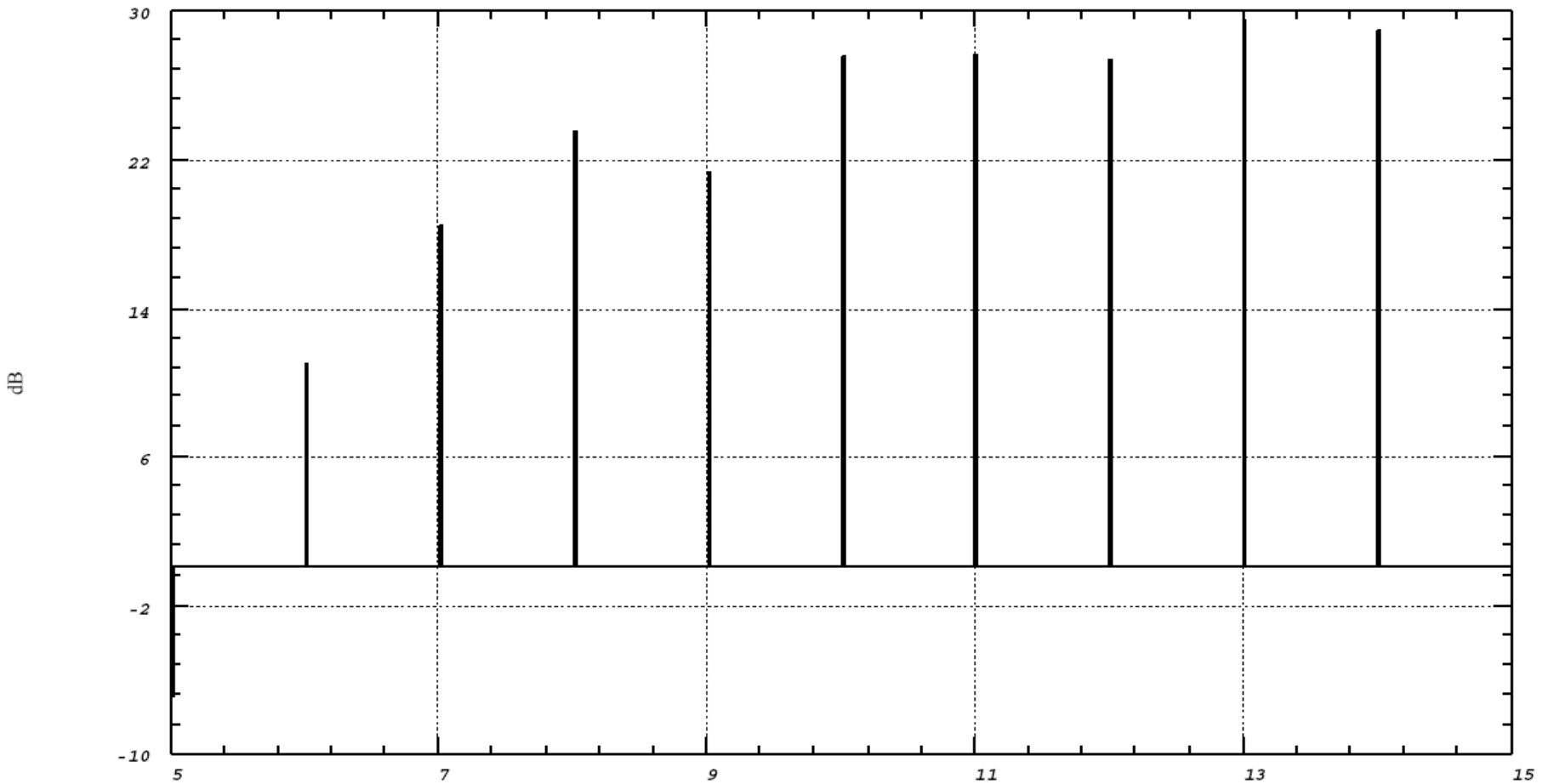


Signal to Error Fixed Point Cascade Form IIR Filter versus Bits

Frequency at 1500 Hz in Stop Band

Fixed Point Cascade Form Band Stop Signal to Error

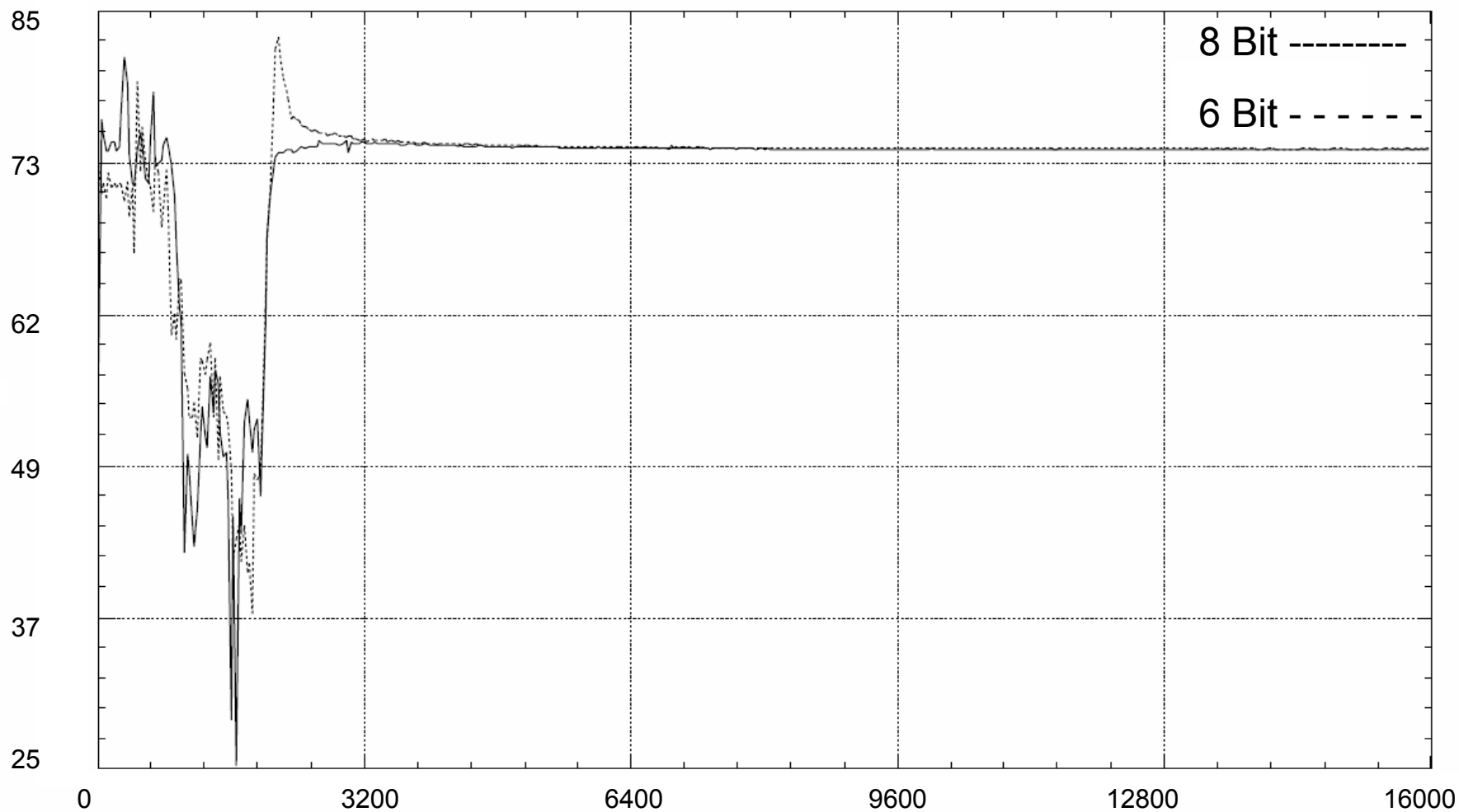
Frequency 1500Hz Rejection Band



Bits

Fixed Point Cascade Form IIR Band Stop Filter

dB



Frequency

Hz

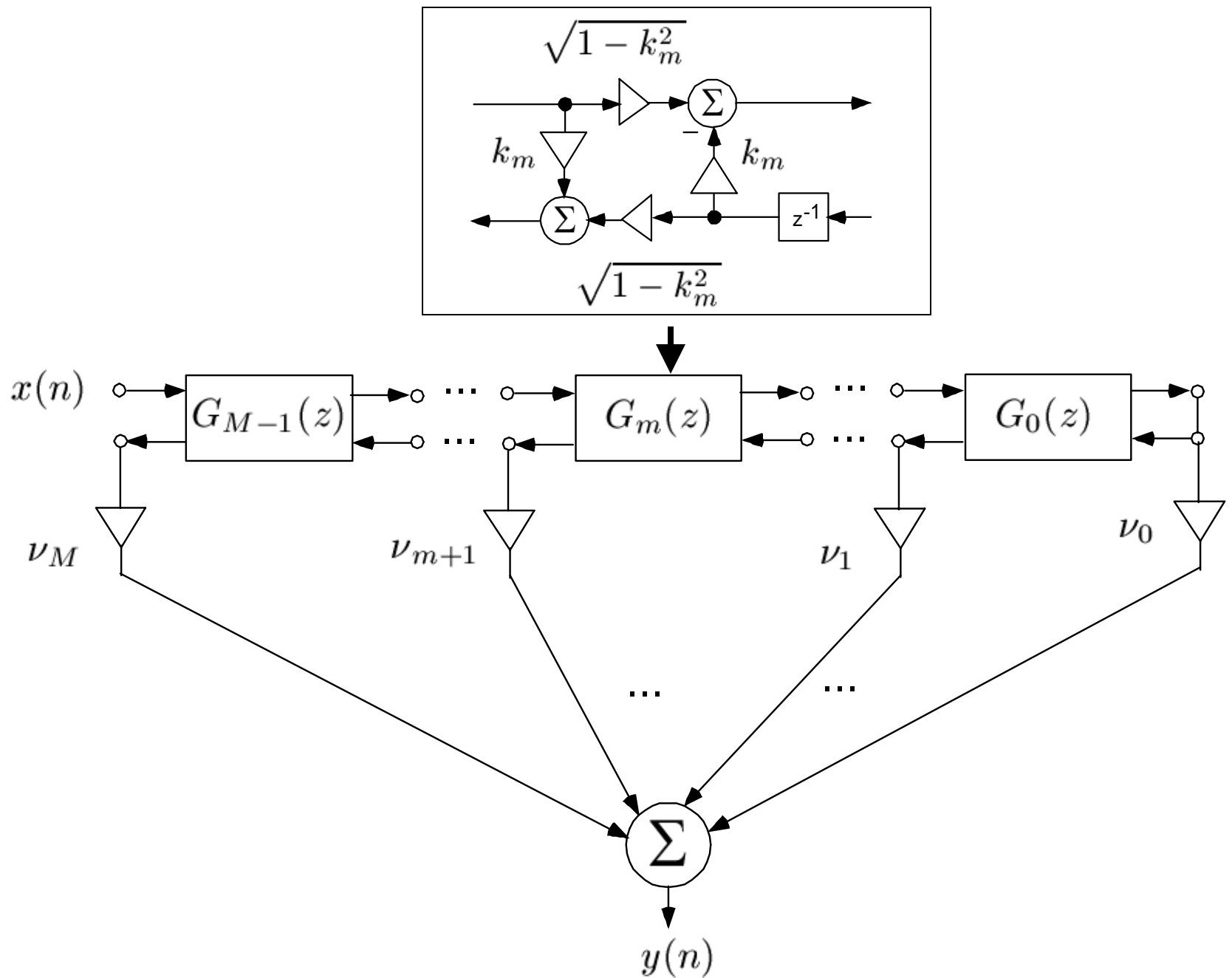
Normalized Lattice Digital Filter

268

IEEE TRANSACTIONS ON ACOUSTICS, SPEECH, AND SIGNAL PROCESSING, VOL. ASSP-23, NO. 3, JUNE 1975

A Normalized Digital Filter Structure

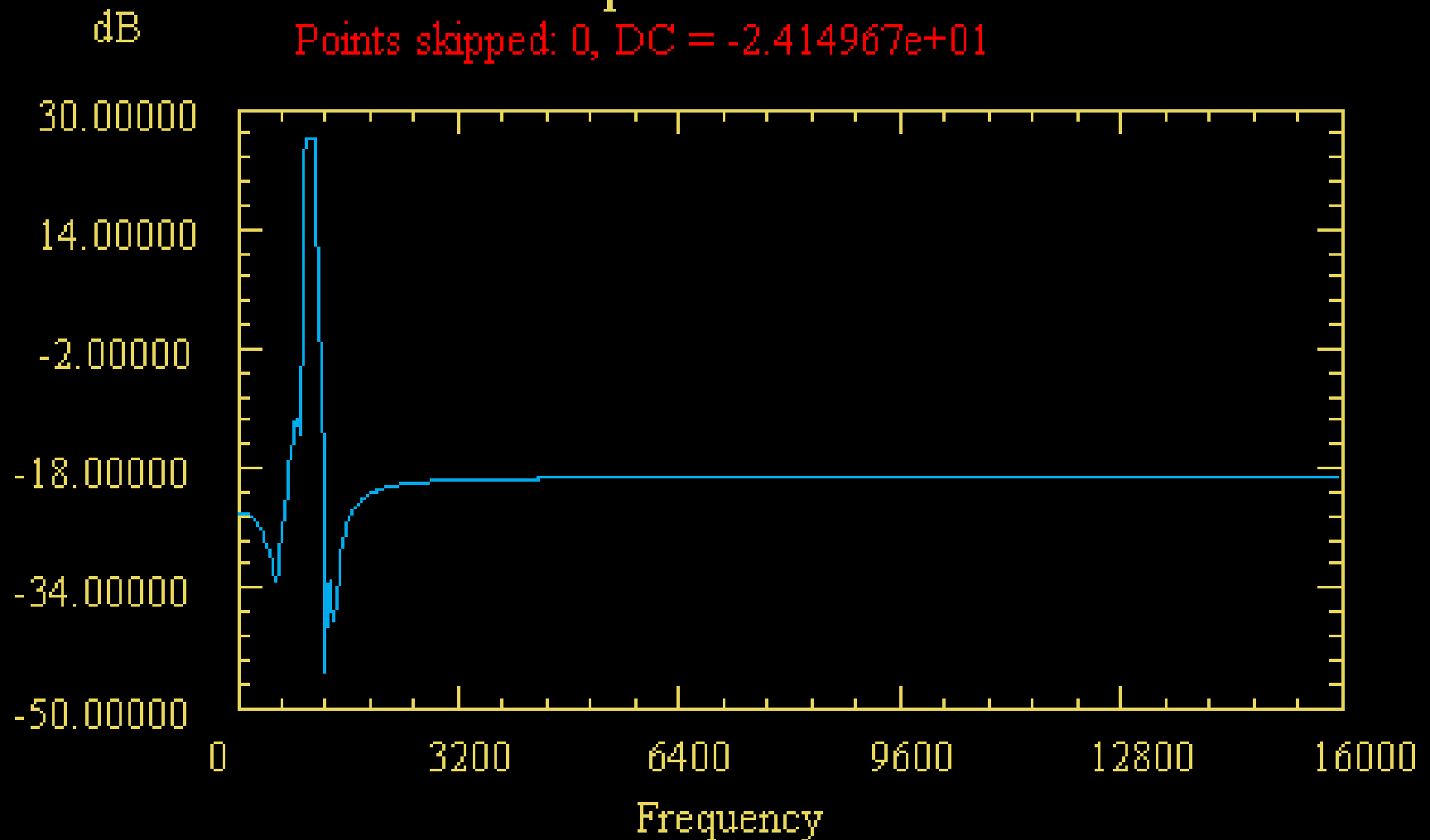
AUGUSTINE H. GRAY, JR., MEMBER, IEEE, AND JOHN D. MARKEL, MEMBER, IEEE



Frequency Response

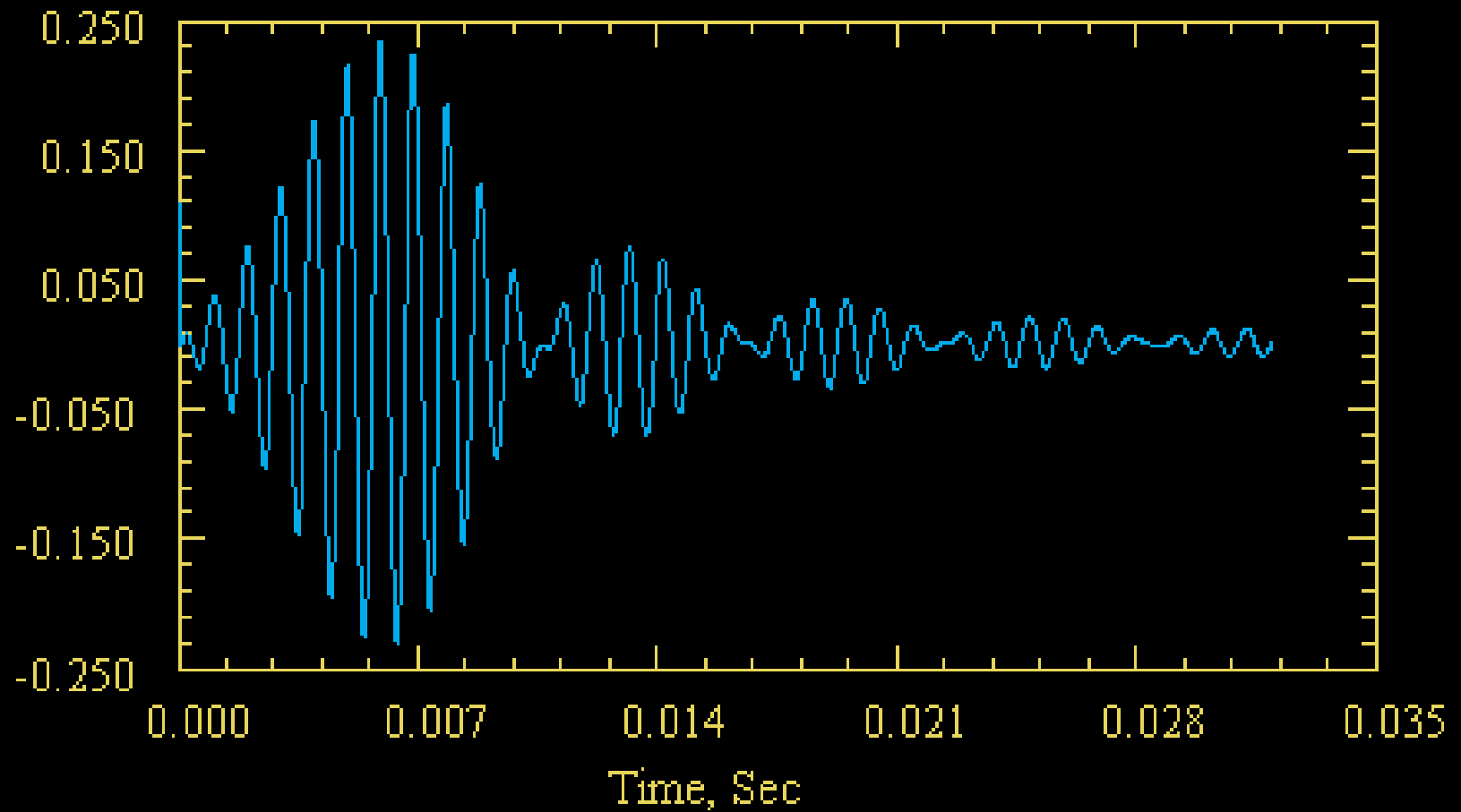
Spectrum nl0:0

Points skipped: 0, DC = -2.414967e+01



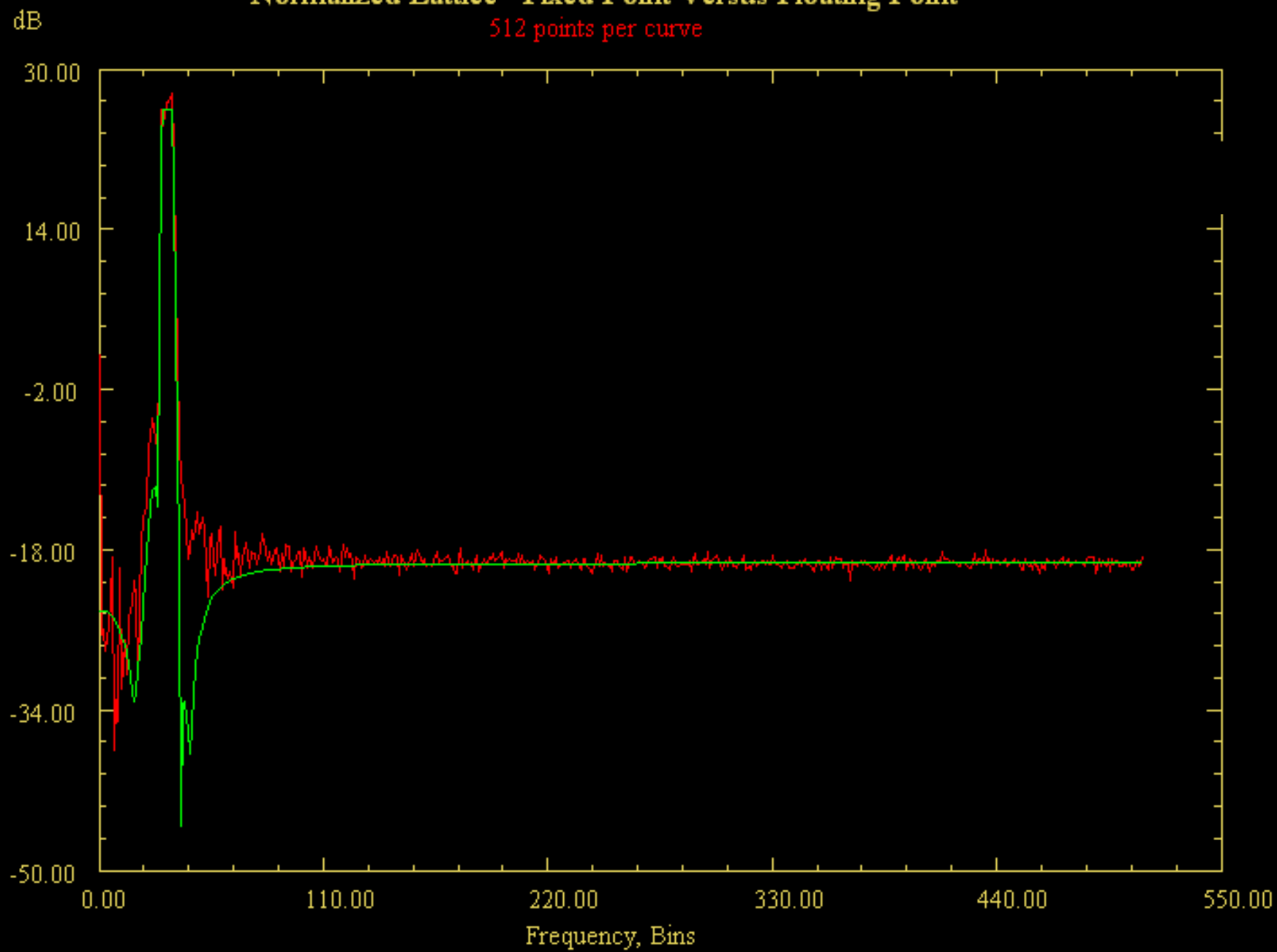
Impulse Response

Time Domain nl0:0



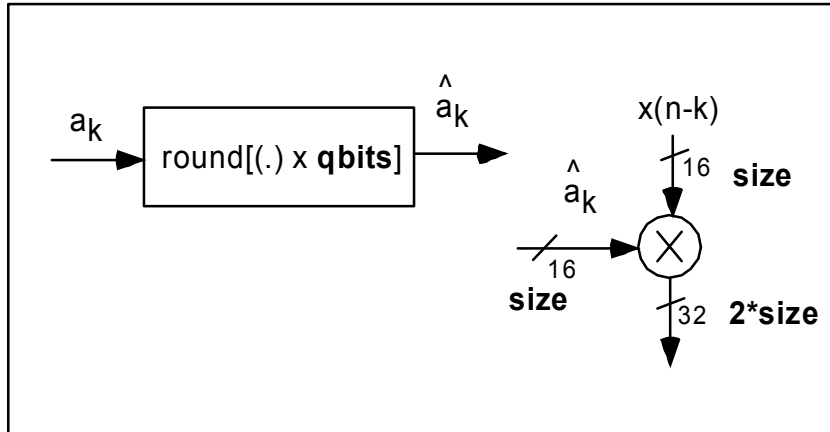
Normalized Lattice Fixed Point Versus Floating Point

512 points per curve



Variable Precision Fixed Point Building Blocks

fxgain



Parameters:

Floating Point Gain
qbits (fraction bits)
Word Length (size)

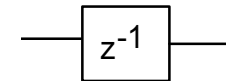
Input Buffers:

Integer

Output Buffer:

Double Precision Integers

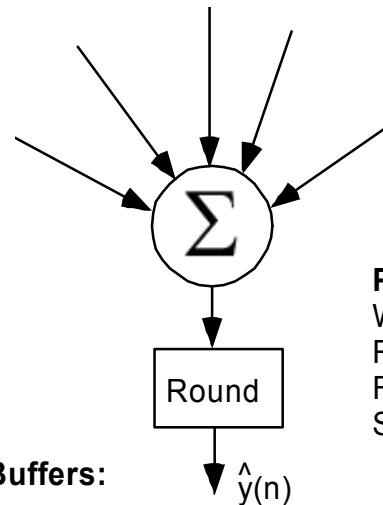
fxdelay



fxadd

Input Buffers:

Double Precision Integers



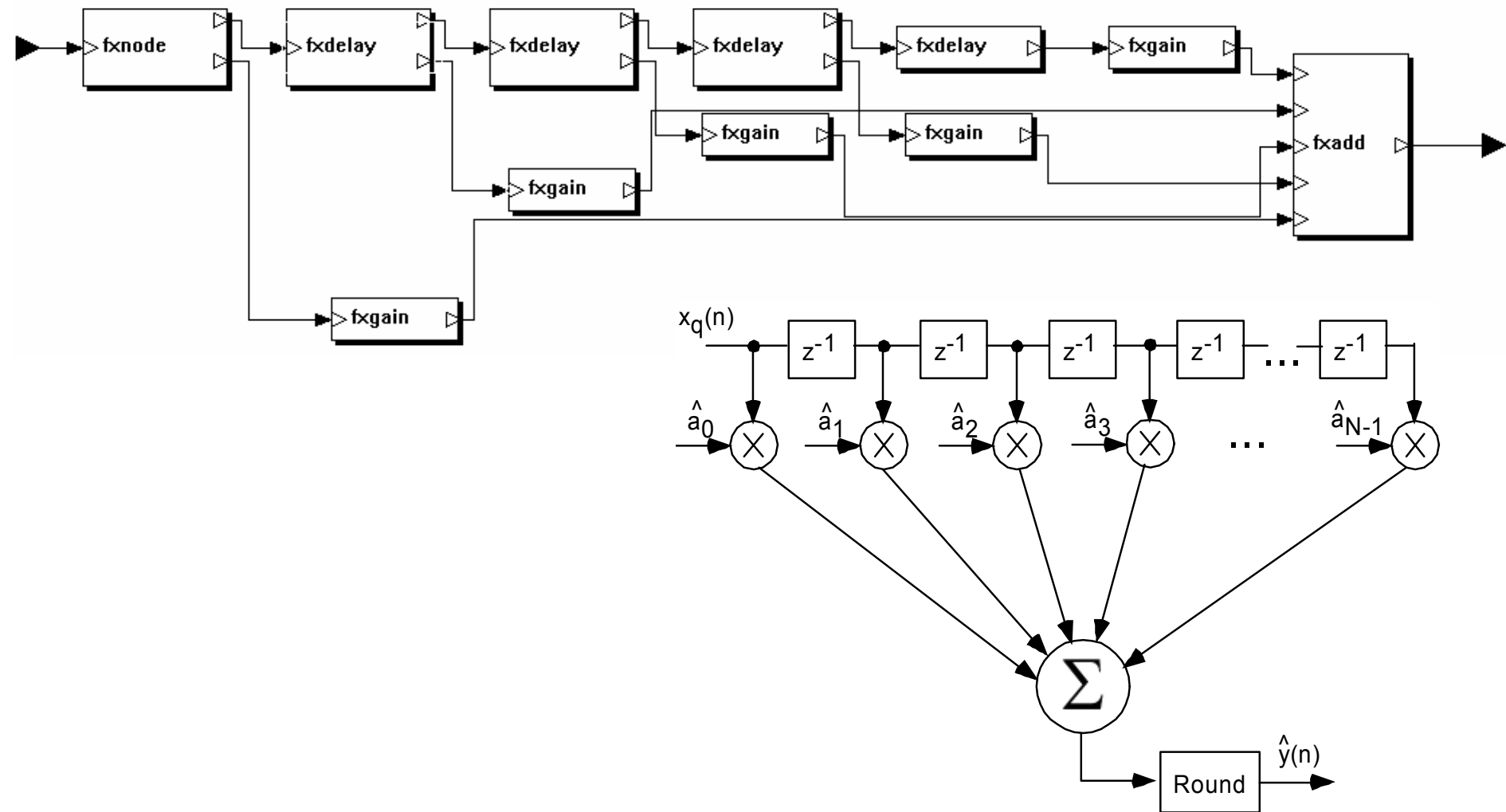
Parameters

Word length of inputs prior to multiplication
Round Off Bits
Final Word Length
Saturation Flag

Output Buffers:

Integers

Fixed Point FIR Filter Hierarchical Block



Variable Size Fixed Point Subroutines

```
int ak, val;
float akFloat;

int ak1, ak0, akLessFlag;
int xk1, xk0, xkLessFlag;

int sum0, sum1;
int out0, out1;

val=1;
val <=<= qbits;

if (akFloat>0.0)
    ak = (int)(akFloat * val + 0.5);
else
    ak = (int)(akFloat * val - 0.5);

Fx_Part(size, ak, &ak1, &ak0, &akLessFlag);
Fx_Part(size, xk, &xk1, &xk0, &xkLessFlag);

Fx_MultVar(akLessFlag, xkLessFlag, size, ak1, ak0, xk1, xk0, &out1, &out0);
Fx_AddVar(size, saturationMode, out1, out0, sum1, sum0, &sum1, &sum0);
Fx_RoundVar(size, accumSizeRound, roundoff_bits, sum1, sum0, &out);
```