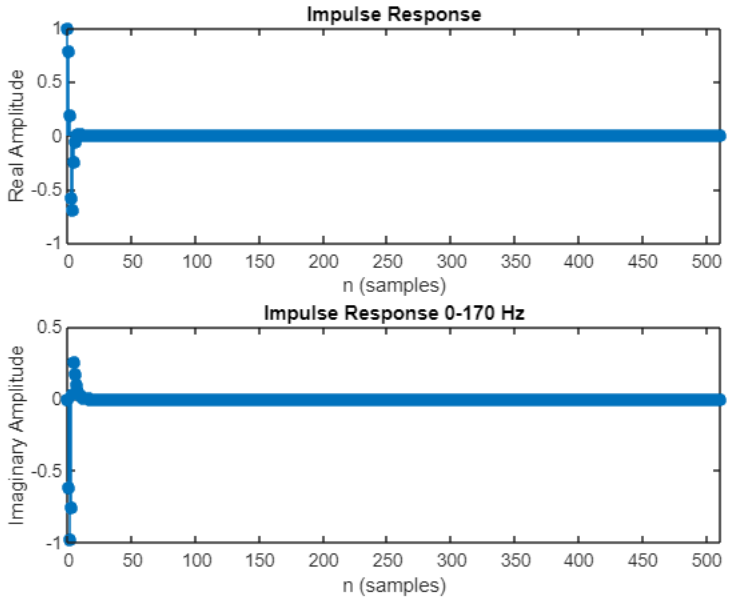
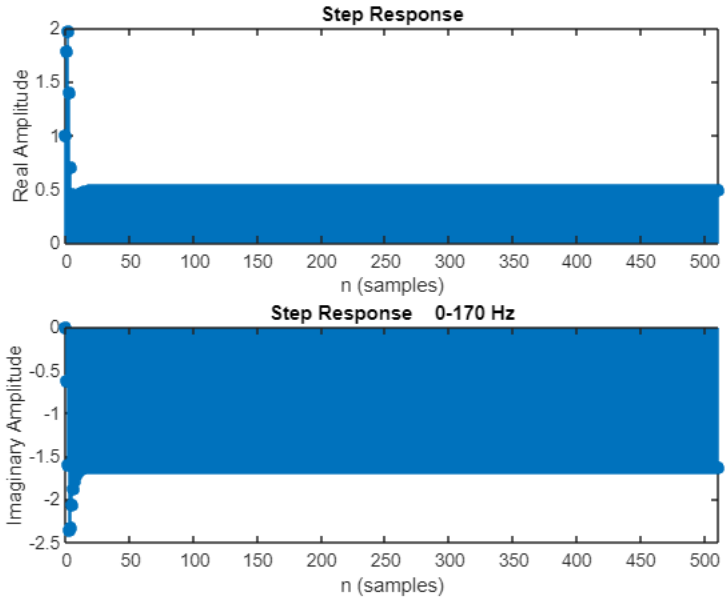
IIR FILTERS ANALYSIS

OMAR IBRAHIM 7442
MAZEN NAGY 7475

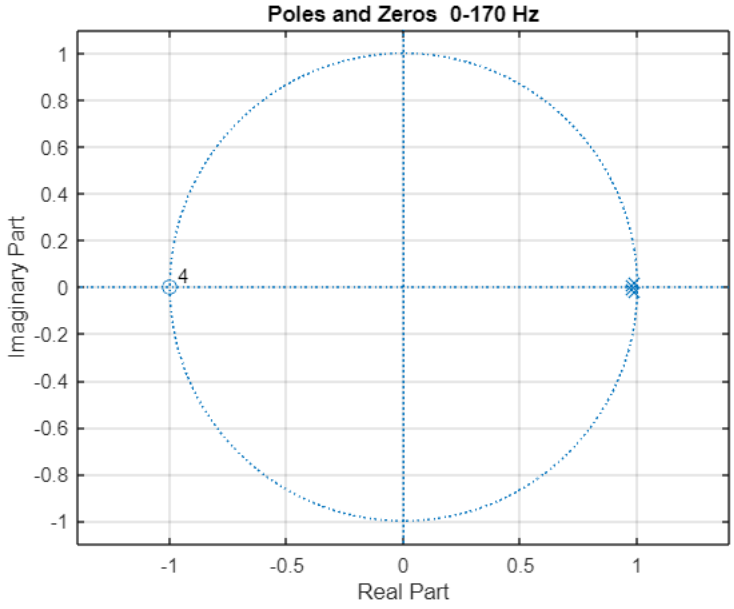
```
fs = 44100;
Frequencies = [170 300 610 1005 3000 6000 12000 14000 20000];
t = 1/fs;
f = fs/2;
order_iir = 4;
[b1 a1] = butter(order_iir, Frequencies(1)/f);
[b2 a2] = butter(order_iir, [Frequencies(1) Frequencies(2)]/f);
[b3 a3] = butter(order_iir, [Frequencies(2) Frequencies(3)]/f);
[b4 a4] = butter(order_iir, [Frequencies(3) Frequencies(4)]/f);
[b5 a5] = butter(order_iir, [Frequencies(4) Frequencies(5)]/f);
[b6 a6] = butter(order_iir, [Frequencies(5) Frequencies(6)]/f);
[b7 a7] = butter(order_iir, [Frequencies(6) Frequencies(7)]/f);
[b8 a8] = butter(order_iir, [Frequencies(7) Frequencies(8)]/f);
[b9 a9] = butter(order_iir, [Frequencies(8) Frequencies(9)]/f);
[H1 w1] = freqz(b1, a1);
[H2 w2] = freqz(b2, a2);
[H3 w3] = freqz(b3, a3);
[H4 w4] = freqz(b4, a4);
[H5 w5] = freqz(b5, a5);
[H6 w6] = freqz(b6, a6);
[H7 w7] = freqz(b7, a7);
[H8 w8] = freqz(b8, a8);
[H9 w9] = freqz(b9, a9);
%0-170 Hz
figure;
impz(H1);
title('Impulse Response 0-170 Hz');
```



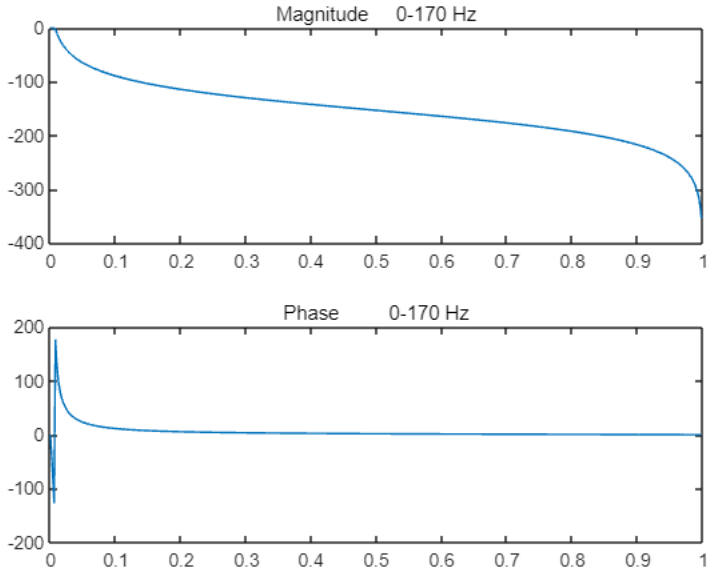

```
figure;
stepz(H1);
title('Step Response    0-170 Hz');
```



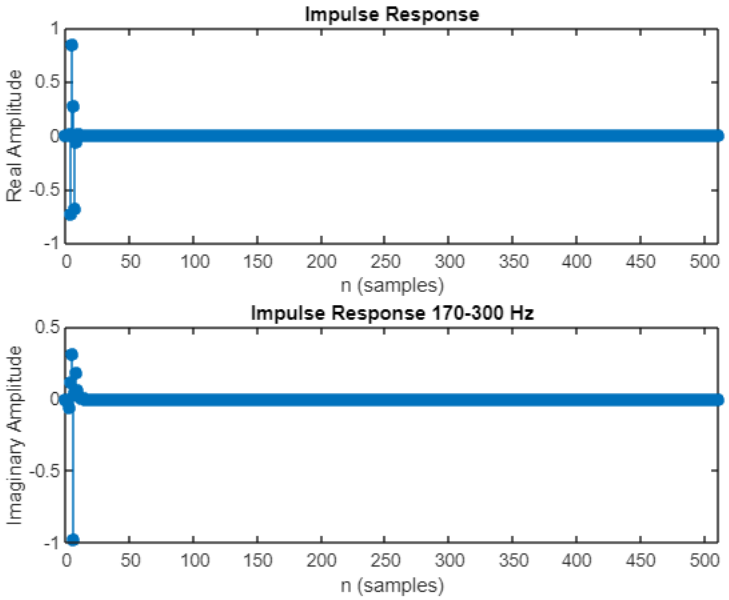

```
figure;
zplane(b1, a1);
grid;
title('Poles and Zeros  0-170 Hz');
```



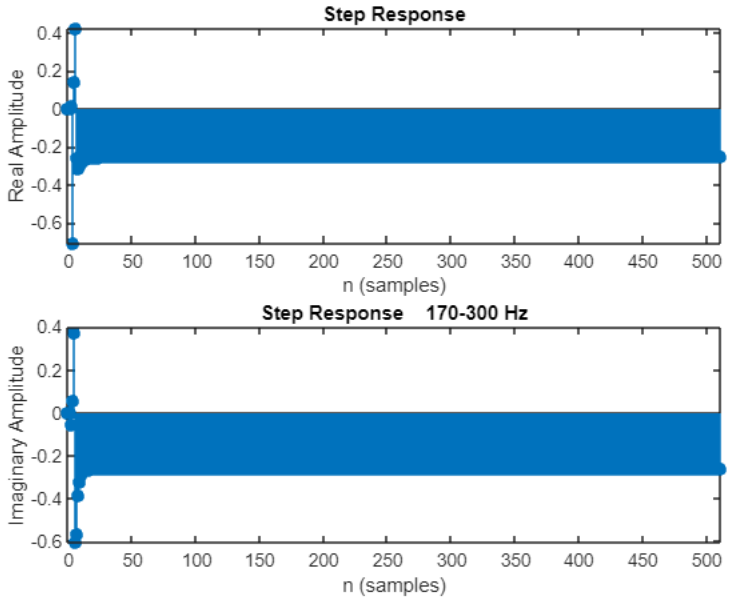

```
figure;
subplot(2, 1, 1);
plot(w1/pi, 20*log10(abs(H1)));
subtitle('Magnitude     0-170 Hz');
subplot(2, 1, 2);
plot(w1/pi, rad2deg(angle(H1)));
subtitle('Phase         0-170 Hz');
```



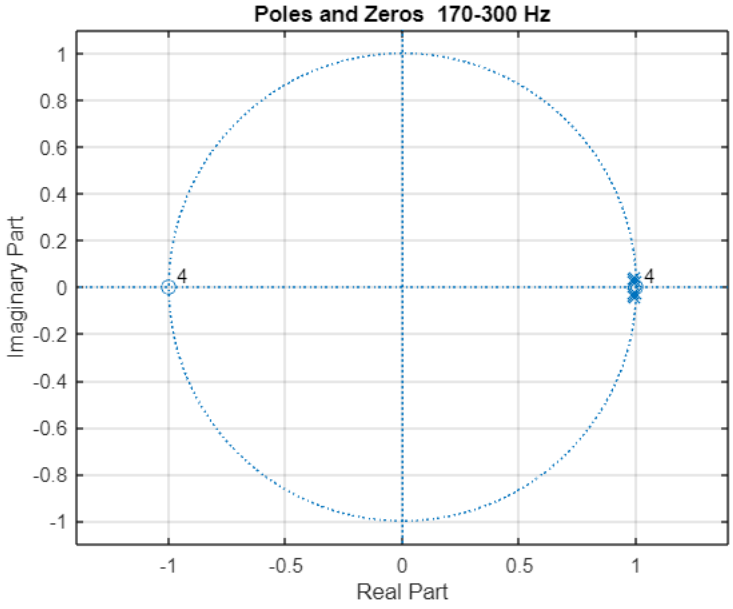

```
%170-300 Hz
figure;
impz(H2);
title('Impulse Response 170-300 Hz');
```



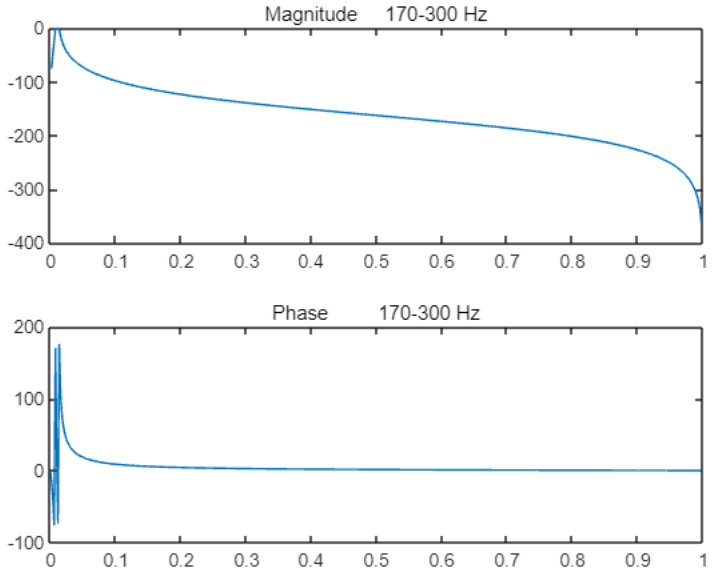

```
figure;
stepz(H2);
title('Step Response    170-300 Hz');
```



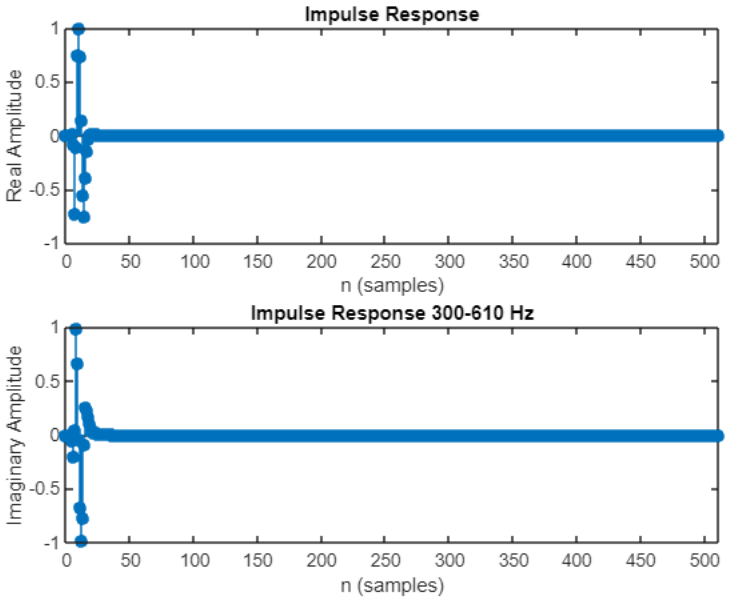

```
figure;
zplane(b2, a2);
grid;
title('Poles and Zeros  170-300 Hz');
```



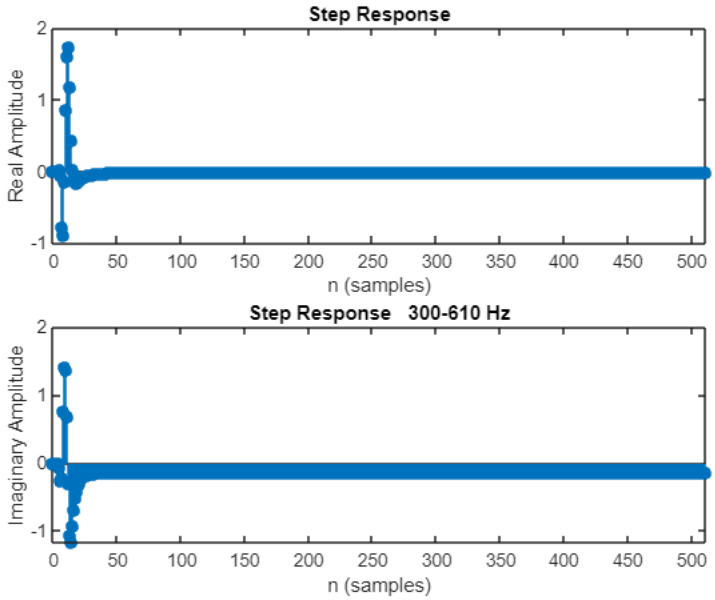

```
figure;
subplot(2, 1, 1);
plot(w1/pi, 20*log10(abs(H2)));
subtitle('Magnitude     170-300 Hz');
subplot(2, 1, 2);
plot(w1/pi, rad2deg(angle(H2)));
subtitle('Phase         170-300 Hz');
```



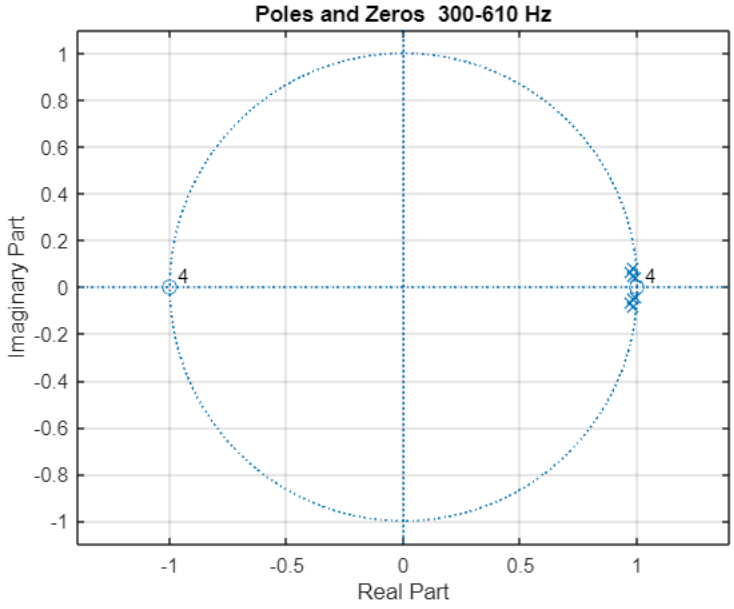

```
%300-610 Hz
figure;
impz(H3);
title('Impulse Response 300-610 Hz');
```



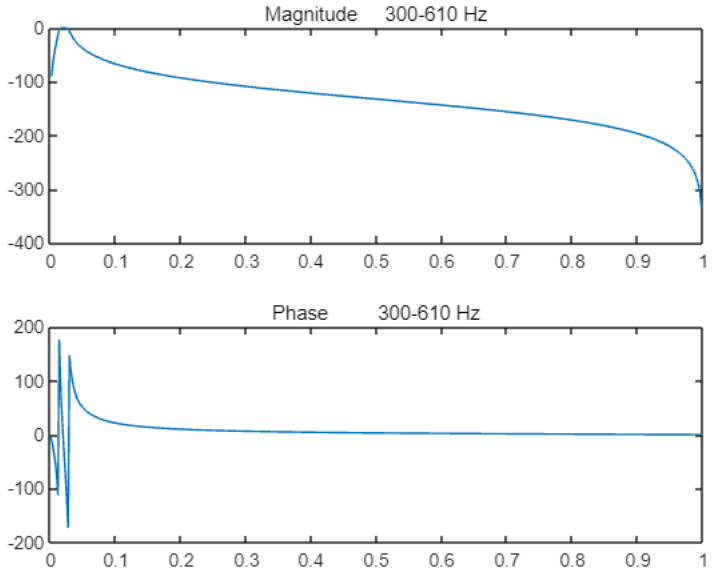

```
figure;
stepz(H3);
title('Step Response   300-610 Hz');
```



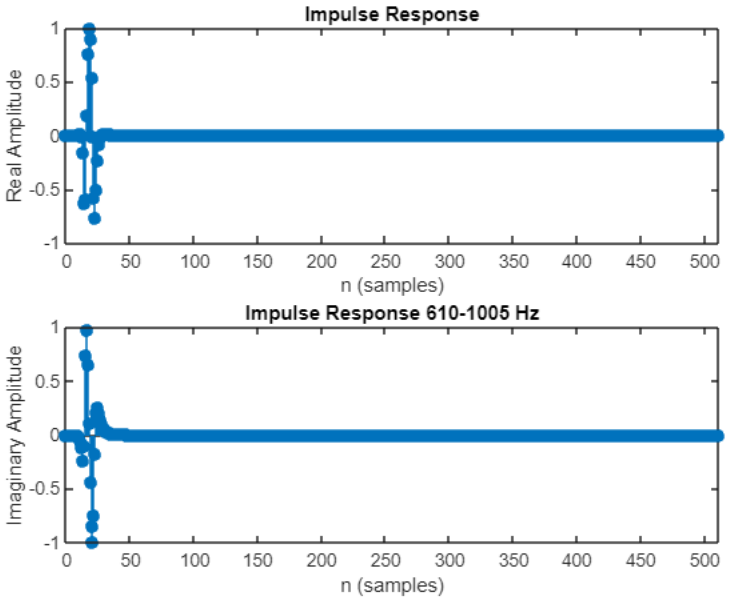

```
figure;
zplane(b3, a3);
grid;
title('Poles and Zeros  300-610 Hz');
```



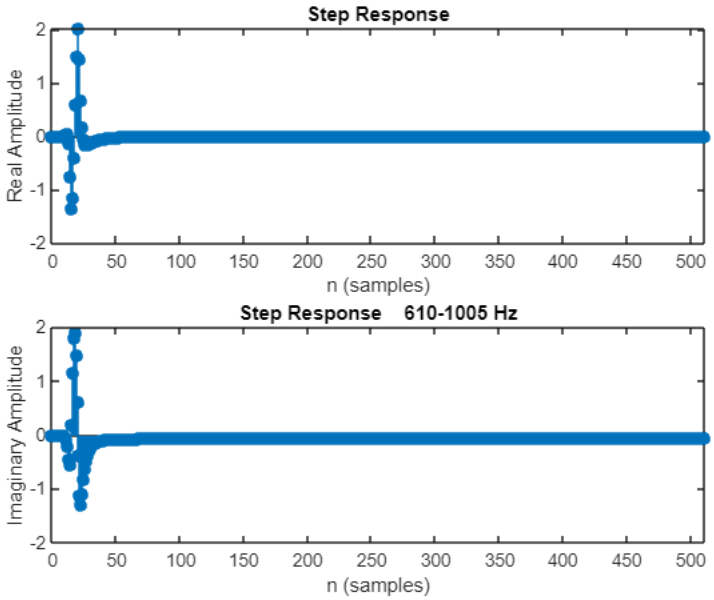

```
figure;
subplot(2, 1, 1);
plot(w1/pi, 20*log10(abs(H3)));
subtitle('Magnitude     300-610 Hz');
subplot(2, 1, 2);
plot(w1/pi, rad2deg(angle(H3)));
subtitle('Phase         300-610 Hz');
```



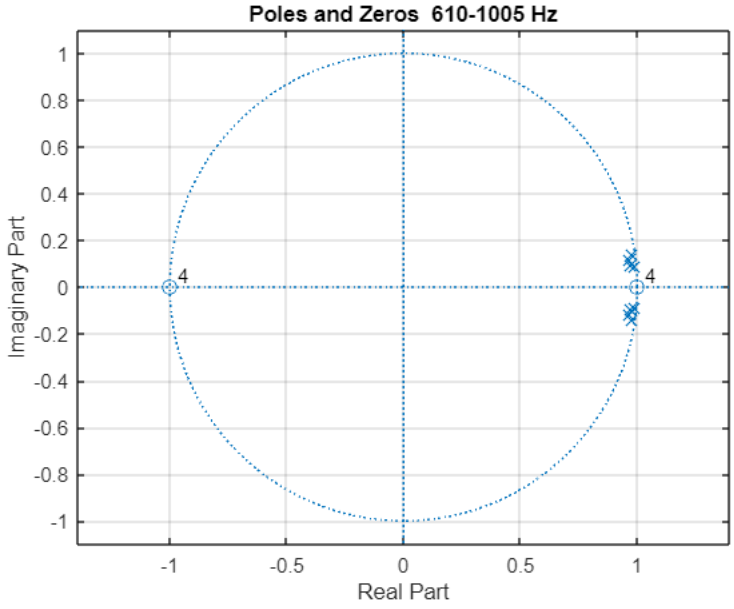

```
%610-1005 Hz
figure;
impz(H4);
title('Impulse Response 610-1005 Hz');
```



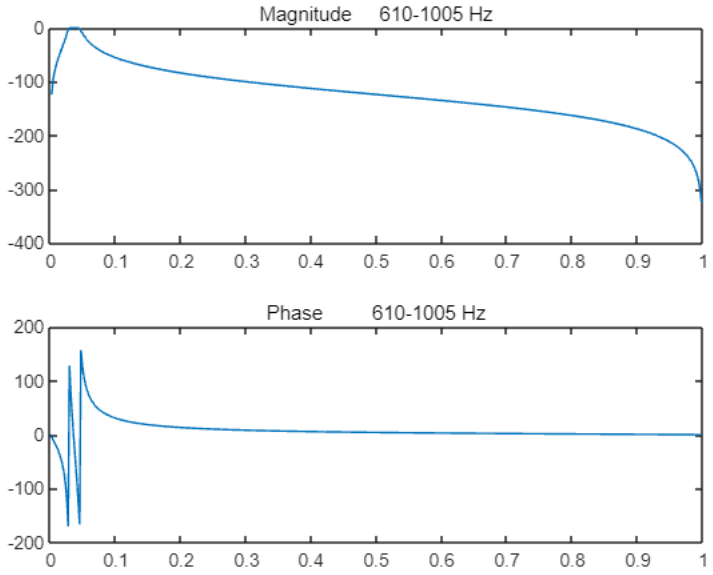

```
figure;
stepz(H4);
title('Step Response    610-1005 Hz');
```



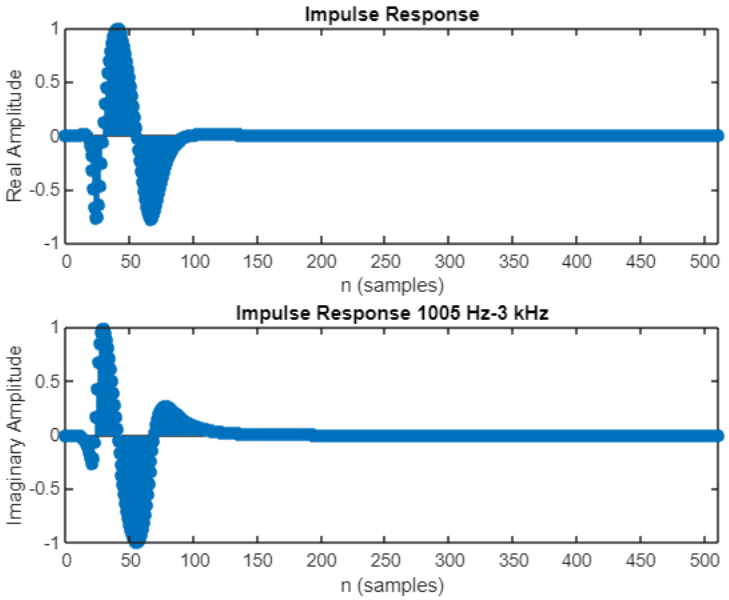

```
figure;
zplane(b4, a4);
grid;
title('Poles and Zeros  610-1005 Hz');
```



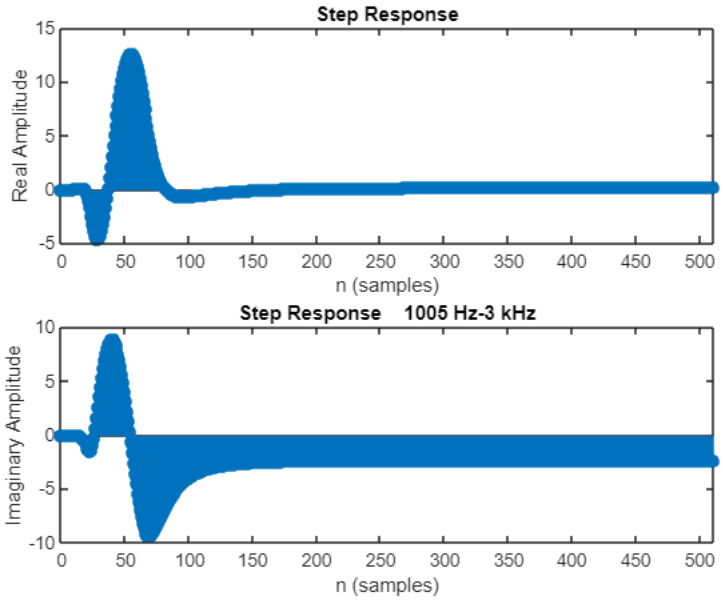

```
figure;
subplot(2, 1, 1);
plot(w1/pi, 20*log10(abs(H4)));
subtitle('Magnitude     610-1005 Hz');
subplot(2, 1, 2);
plot(w1/pi, rad2deg(angle(H4)));
subtitle('Phase         610-1005 Hz');
```



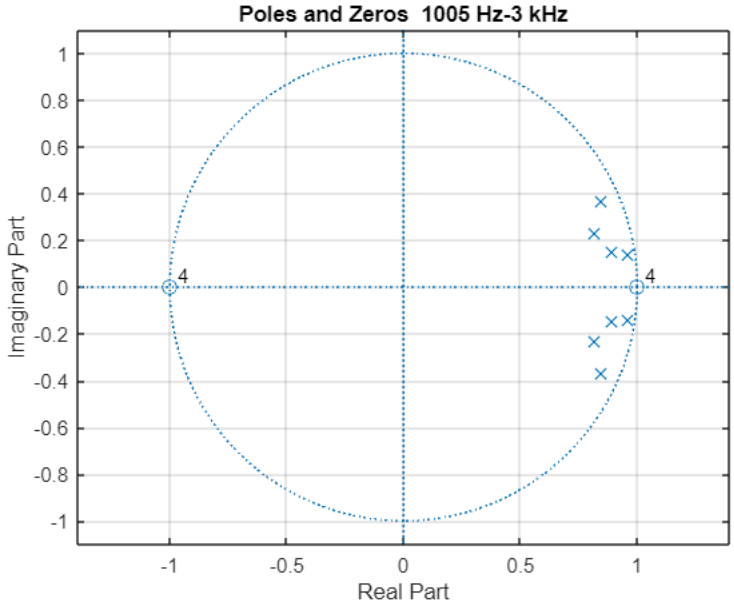

```
%1005 Hz-3 kHz
figure;
impz(H5);
title('Impulse Response 1005 Hz-3 kHz');
```



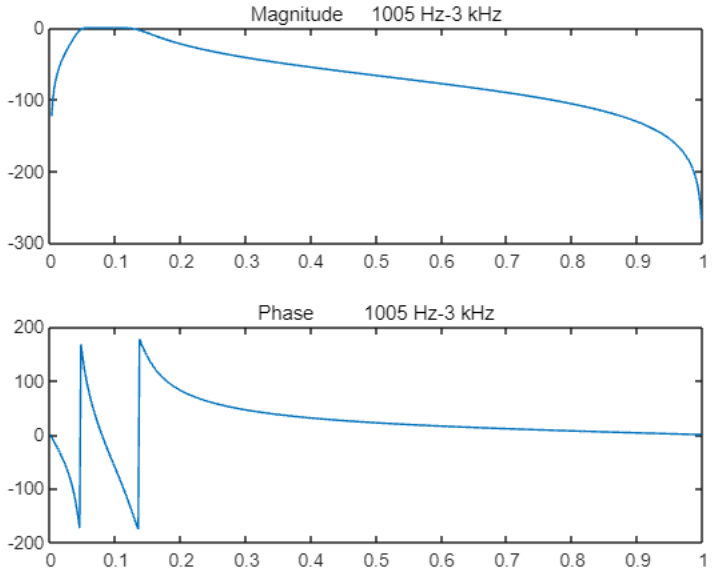

```
figure;
stepz(H5);
title('Step Response    1005 Hz-3 kHz');
```



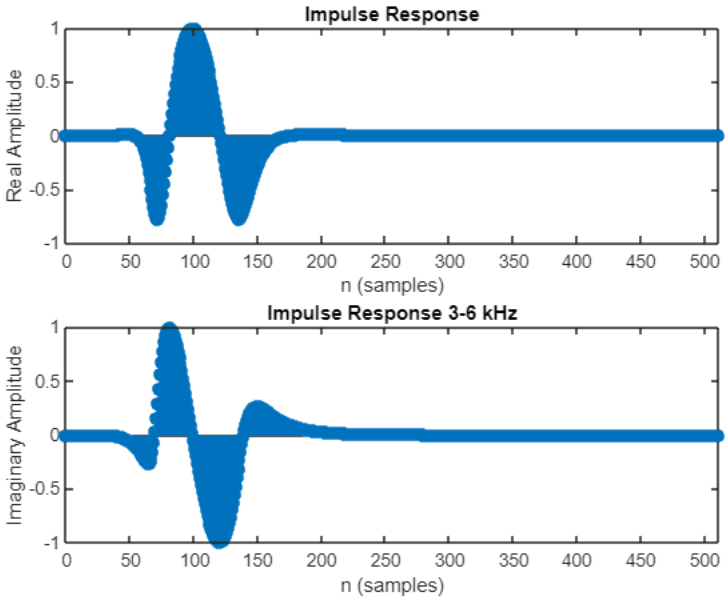

```
figure;
zplane(b5, a5);
grid;
title('Poles and Zeros  1005 Hz-3 kHz');
```



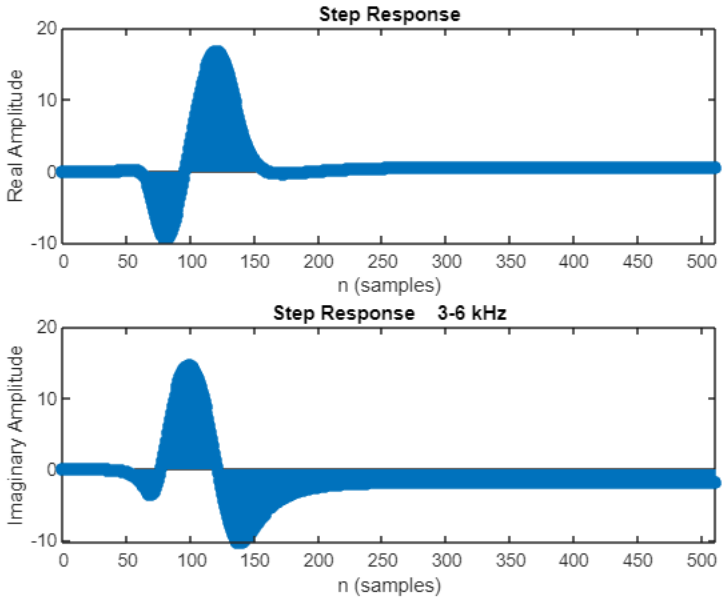

```
figure;
subplot(2, 1, 1);
plot(w1/pi, 20*log10(abs(H5)));
subtitle('Magnitude     1005 Hz-3 kHz');
subplot(2, 1, 2);
plot(w1/pi, rad2deg(angle(H5)));
subtitle('Phase         1005 Hz-3 kHz');
```



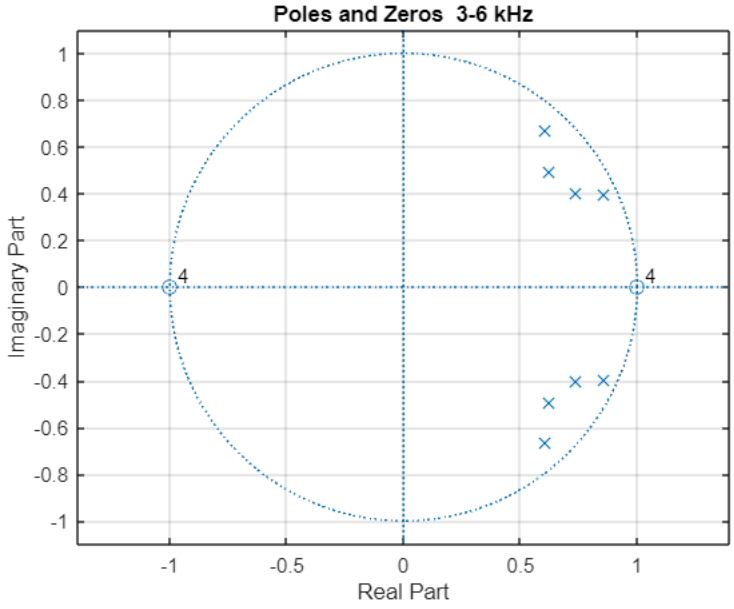

```
%3-6 kHz
figure;
impz(H6);
title('Impulse Response 3-6 kHz');
```



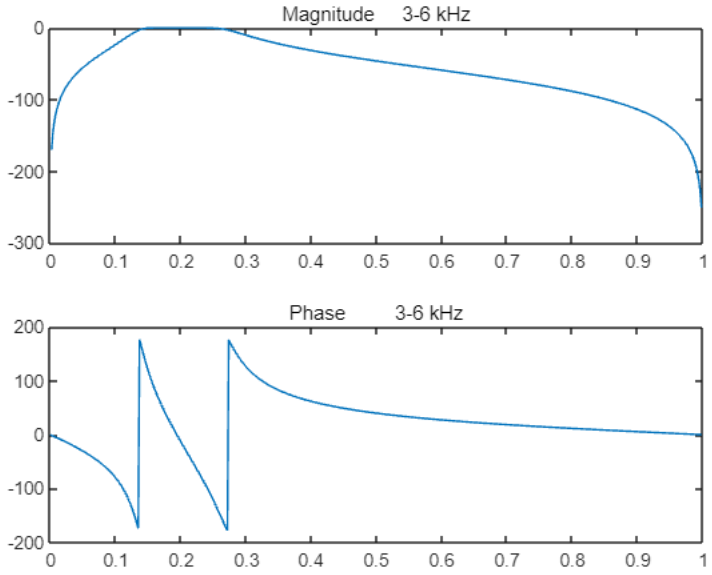

```
figure;
stepz(H6);
title('Step Response    3-6 kHz');
```



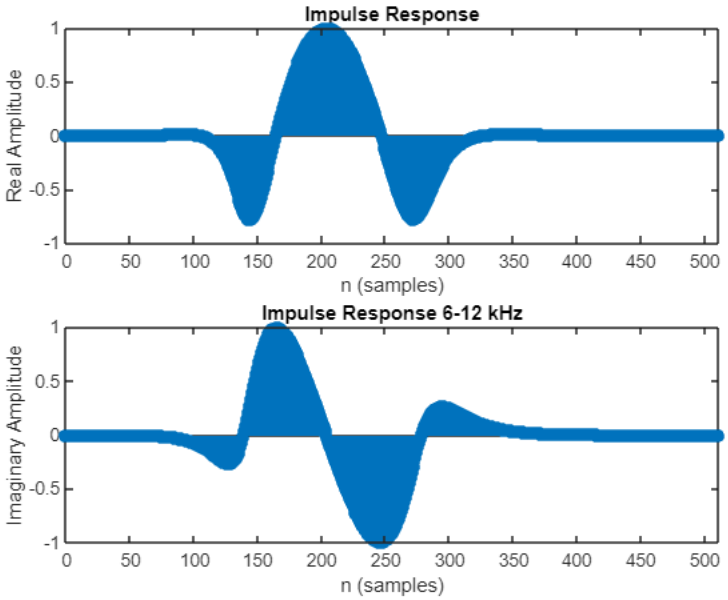

```
figure;
zplane(b6, a6);
grid;
title('Poles and Zeros  3-6 kHz');
```



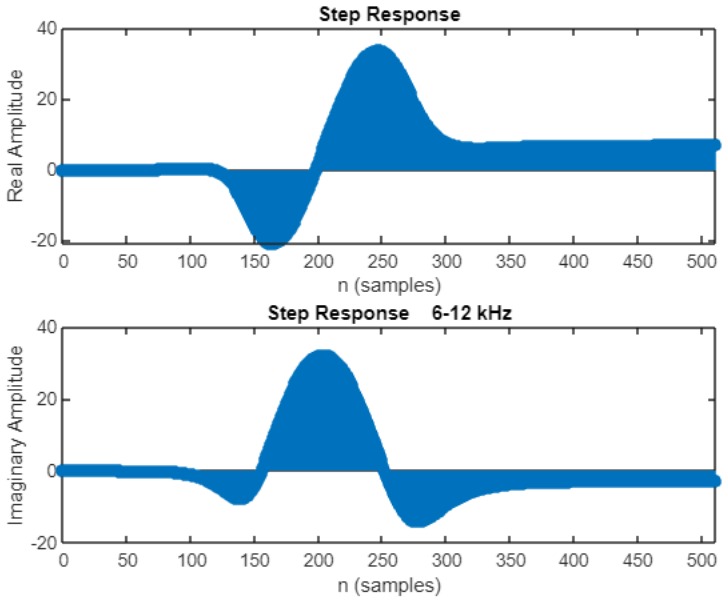

```
figure;
subplot(2, 1, 1);
plot(w1/pi, 20*log10(abs(H6)));
subtitle('Magnitude     3-6 kHz');
subplot(2, 1, 2);
plot(w1/pi, rad2deg(angle(H6)));
subtitle('Phase         3-6 kHz');
```



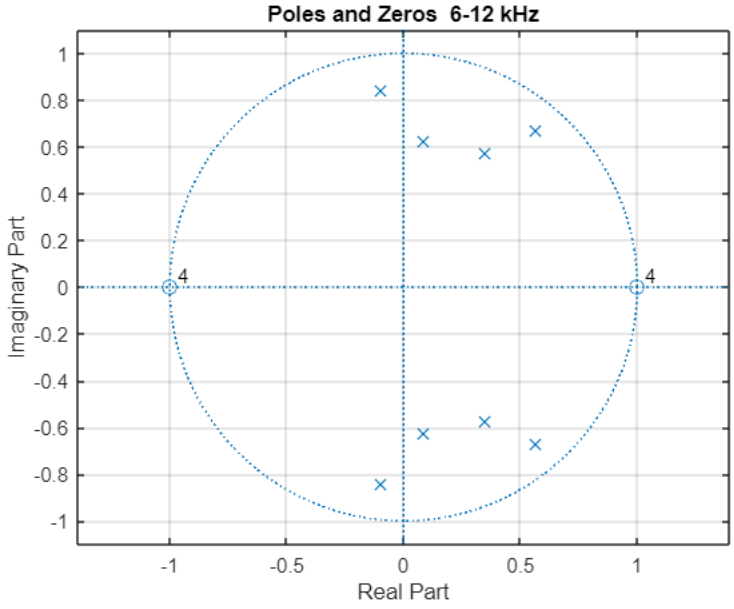

```
%6-12 kHz
figure;
impz(H7);
title('Impulse Response 6-12 kHz');
```



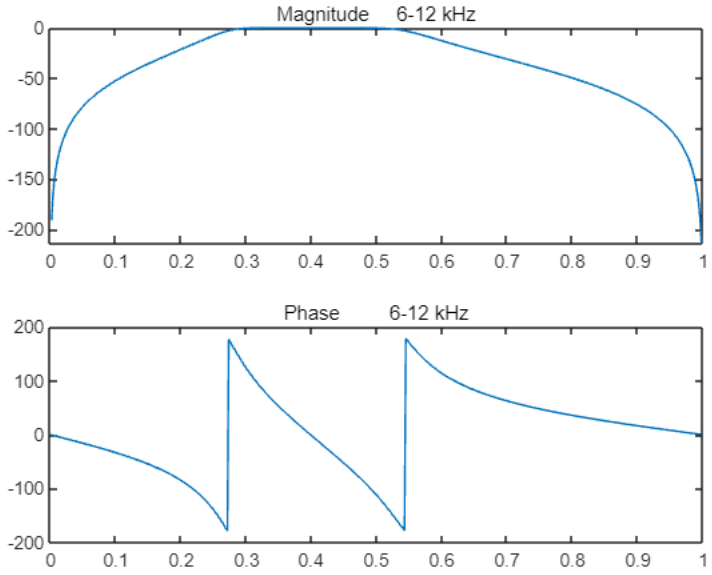

```
figure;
stepz(H7);
title('Step Response    6-12 kHz');
```



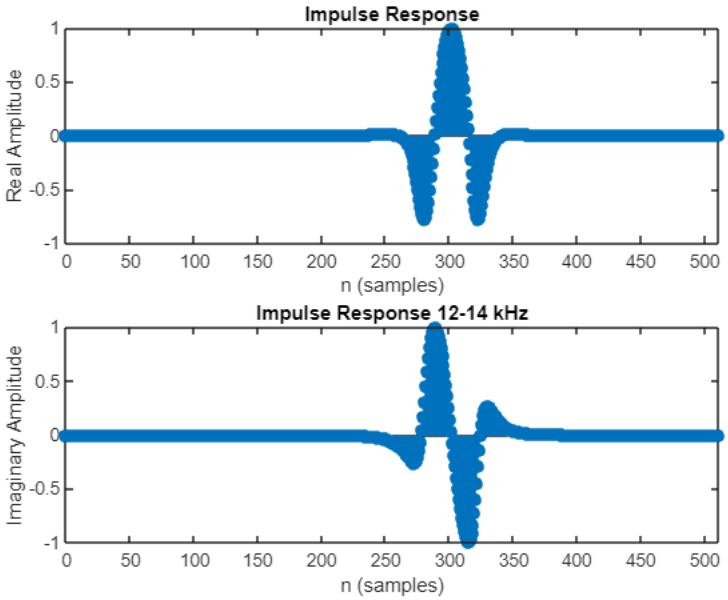

```
figure;
zplane(b7, a7);
grid;
title('Poles and Zeros  6-12 kHz');
```



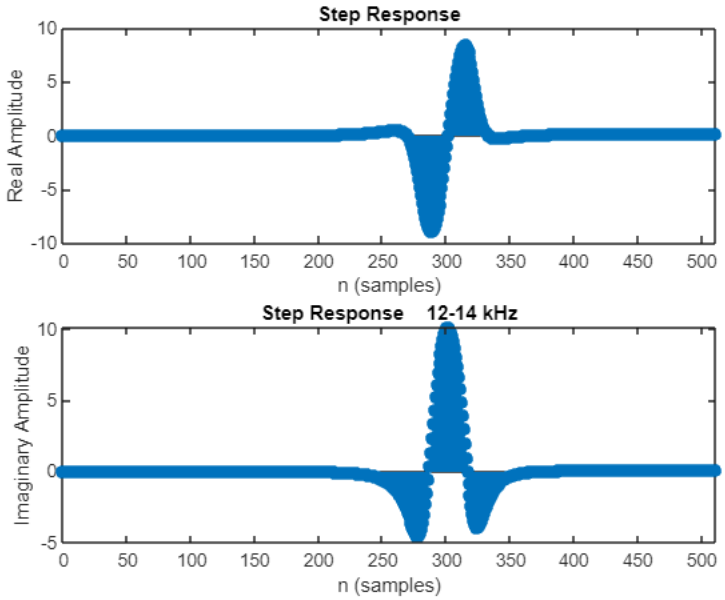

```
figure;
subplot(2, 1, 1);
plot(w1/pi, 20*log10(abs(H7)));
subtitle('Magnitude     6-12 kHz');
subplot(2, 1, 2);
plot(w1/pi, rad2deg(angle(H7)));
subtitle('Phase         6-12 kHz');
```



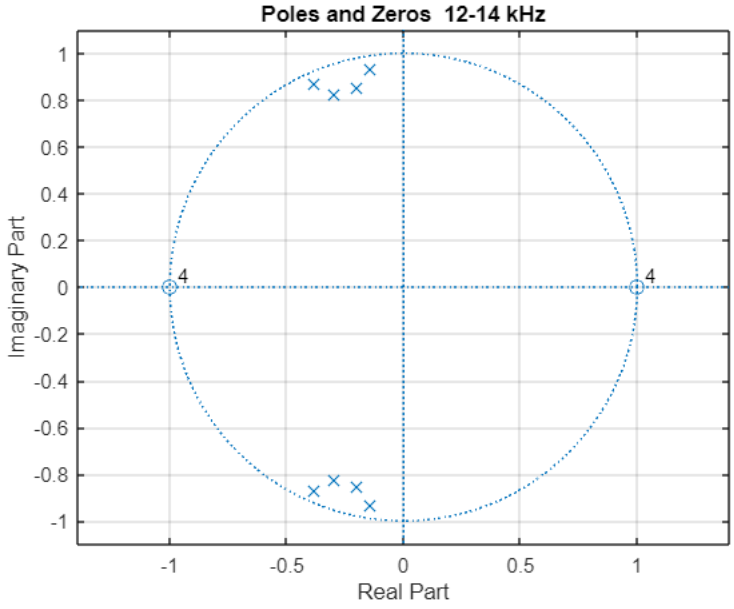

```
%12-14 kHz
figure;
impz(H8);
title('Impulse Response 12-14 kHz');
```



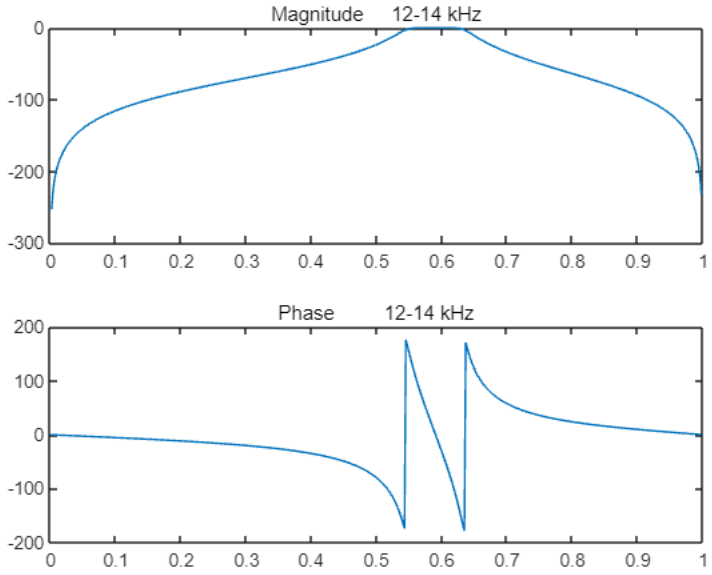

```
figure;
stepz(H8);
title('Step Response    12-14 kHz');
```



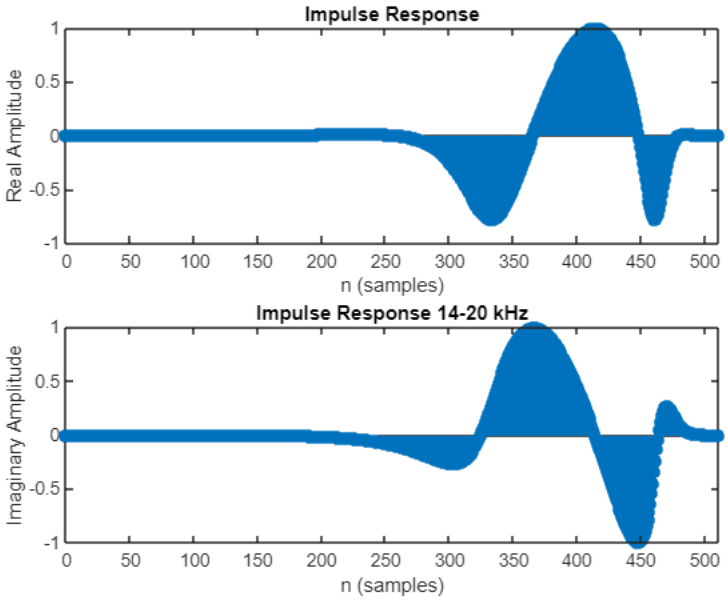

```
figure;
zplane(b8, a8);
grid;
title('Poles and Zeros  12-14 kHz');
```



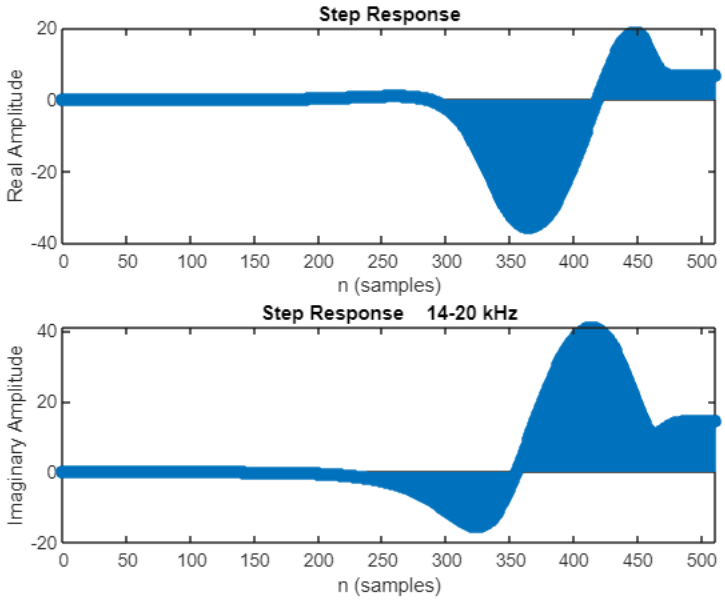

```
figure;
subplot(2, 1, 1);
plot(w1/pi, 20*log10(abs(H8)));
subtitle('Magnitude     12-14 kHz');
subplot(2, 1, 2);
plot(w1/pi, rad2deg(angle(H8)));
subtitle('Phase         12-14 kHz');
```



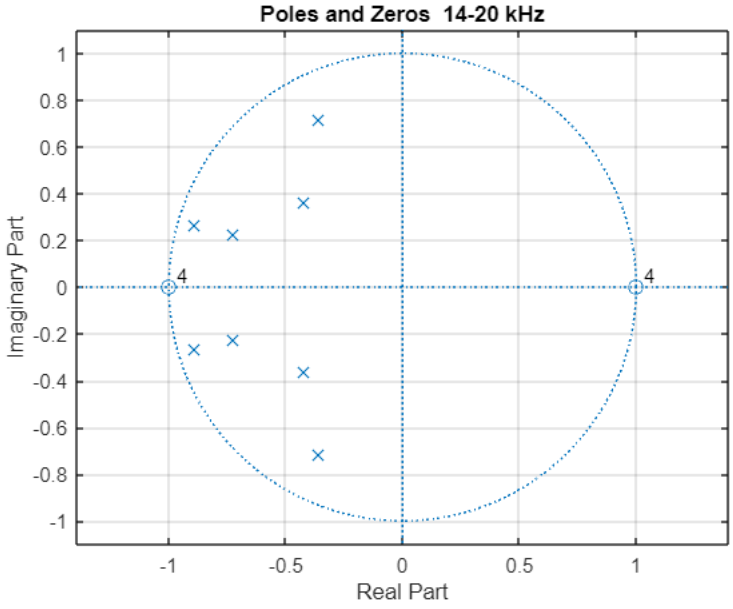

```
%14-20 kHz
figure;
impz(H9);
title('Impulse Response 14-20 kHz');
```



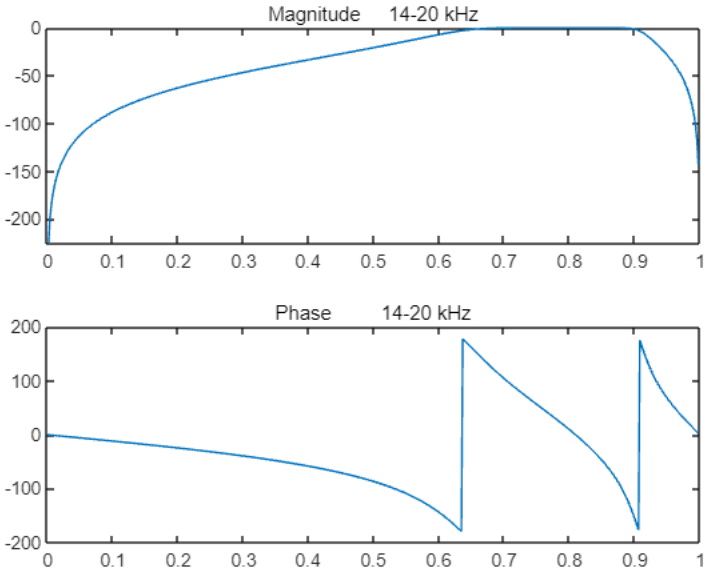

```
figure;
stepz(H9);
title('Step Response    14-20 kHz');
```




```
figure;
zplane(b9, a9);
grid;
title('Poles and Zeros  14-20 kHz');
```




```
figure;
subplot(2, 1, 1);
plot(w1/pi, 20*log10(abs(H9)));
subtitle('Magnitude     14-20 kHz');
subplot(2, 1, 2);
plot(w1/pi, rad2deg(angle(H9)));
subtitle('Phase         14-20 kHz');
```


Magnitude 14-20 kHz
0
-50
-100
-150
-200
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

Phase 14-20 kHz
200
100
0
-100
-200
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1