Instrument Equalizer

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Background :
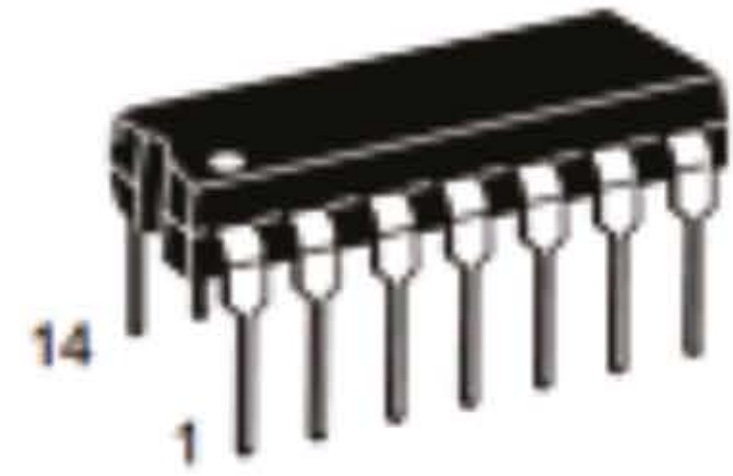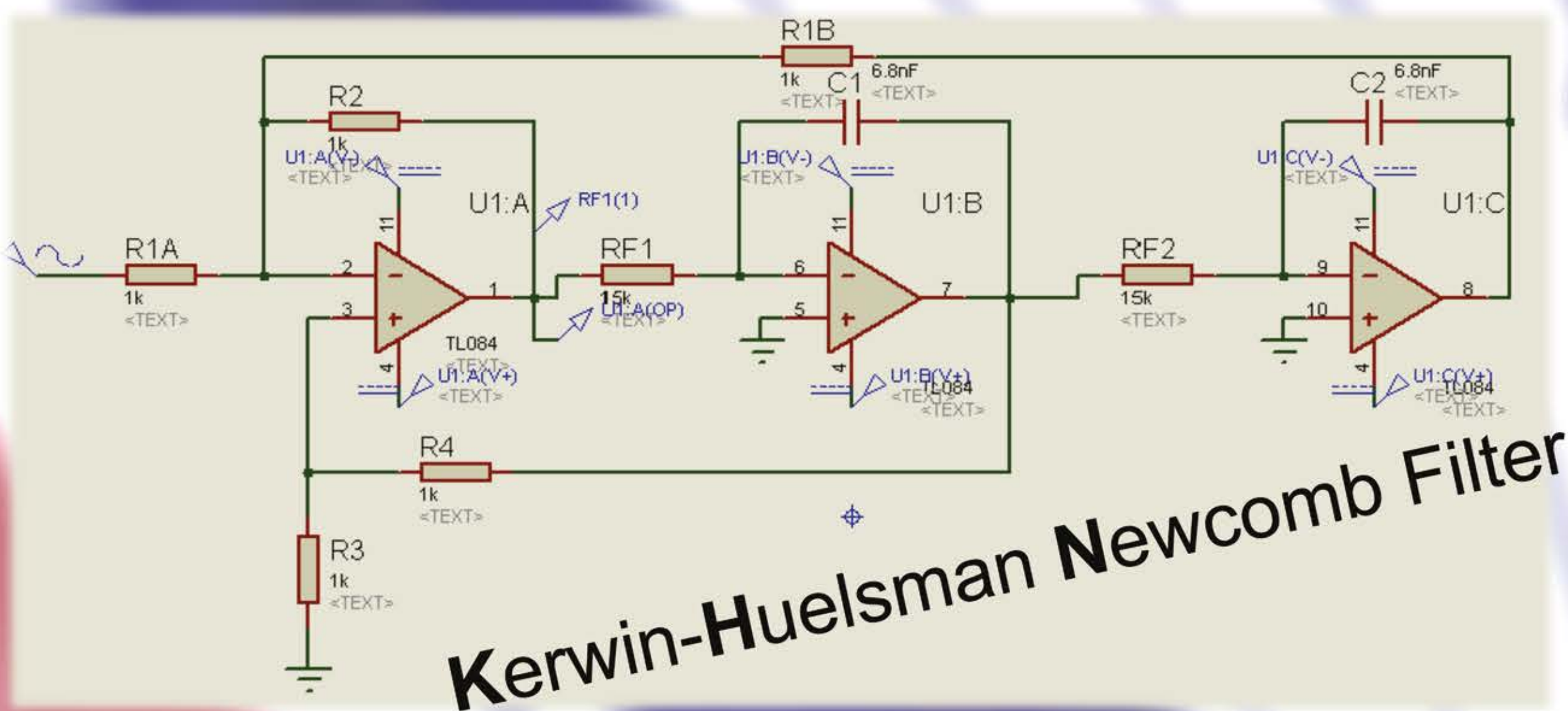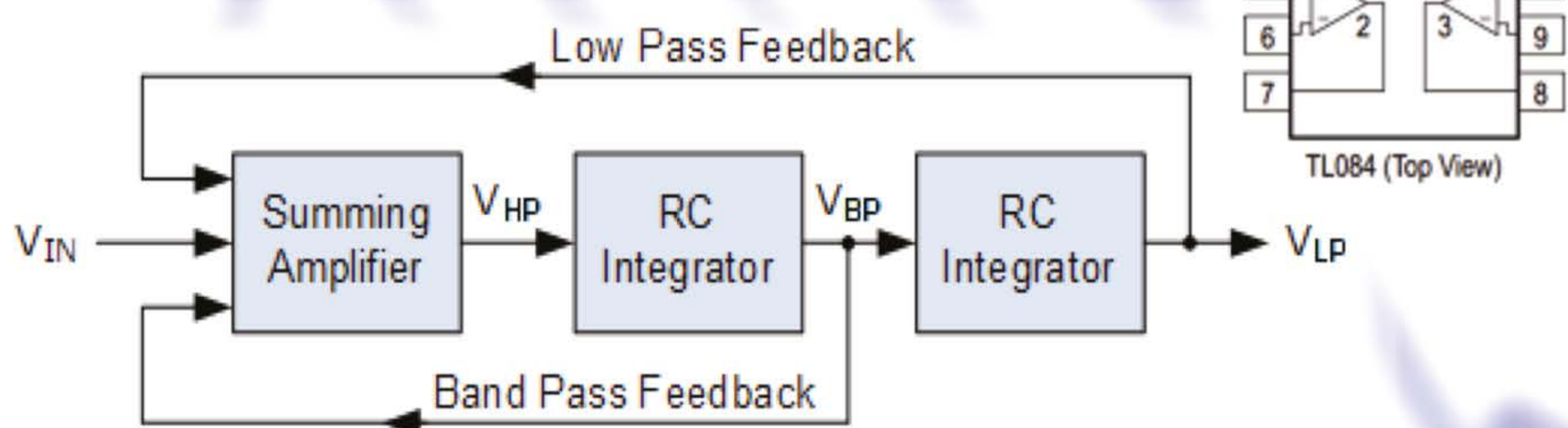
Busking is famous street performance in Hong Kong. Performer brings their own instrument. However, busking amplifier has limitations that cannot perform the music very well. Multi-function instrument equalizer is necessary to provide a varied music effect.
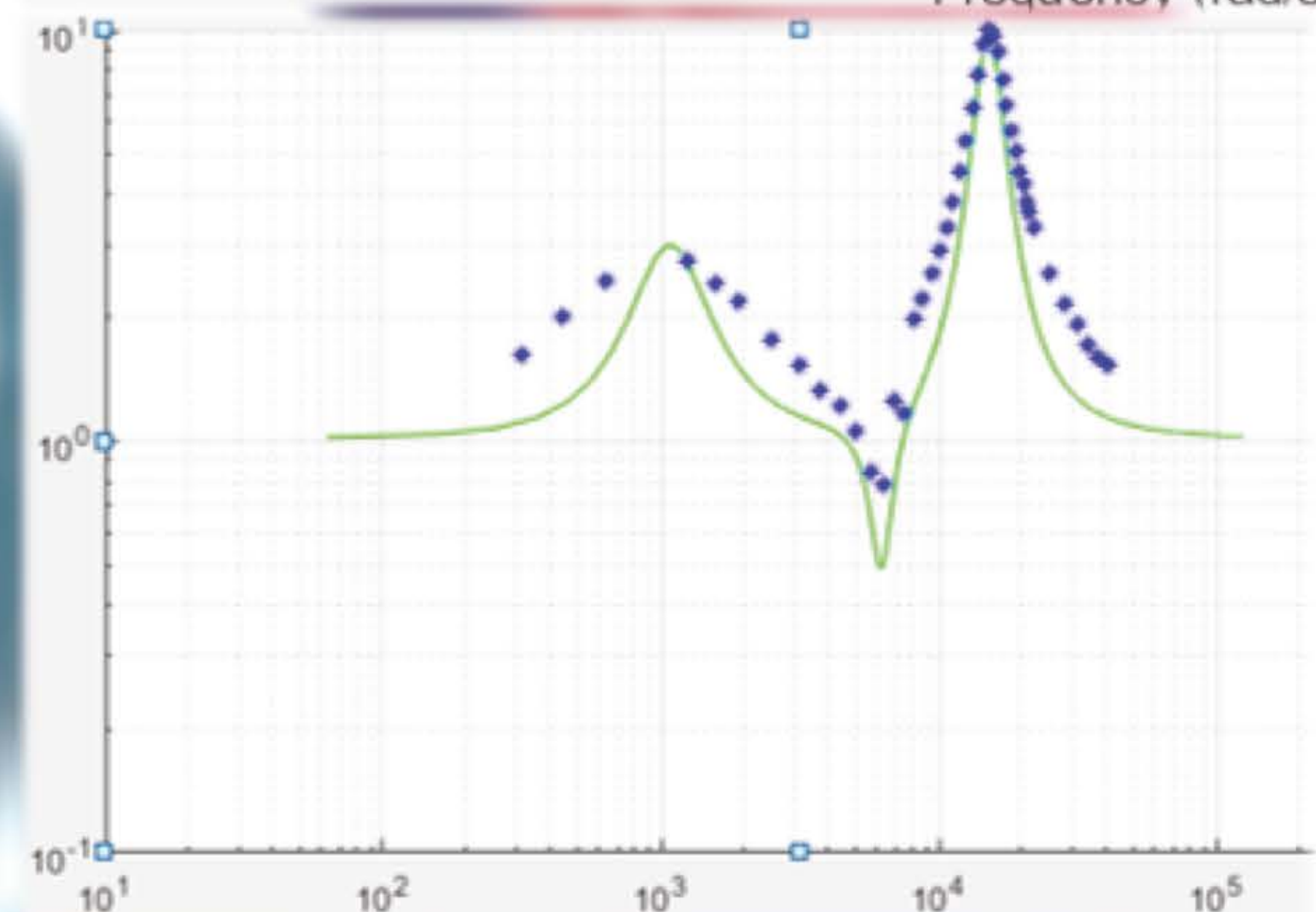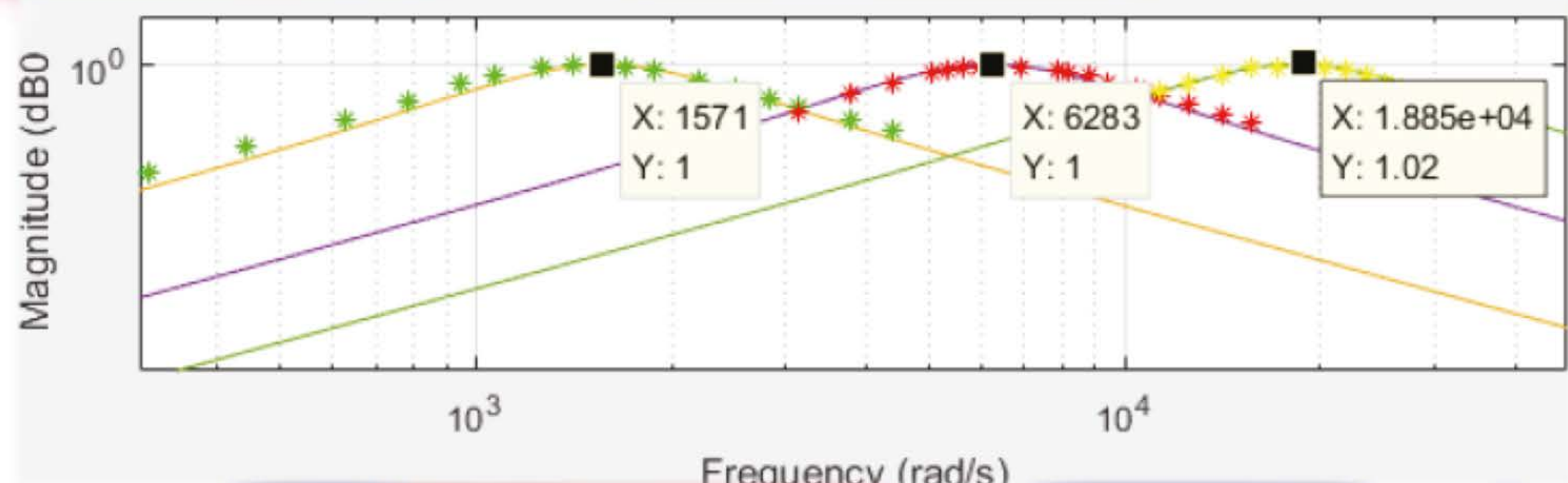
Methodology :

- Analog signal Processing-op amp
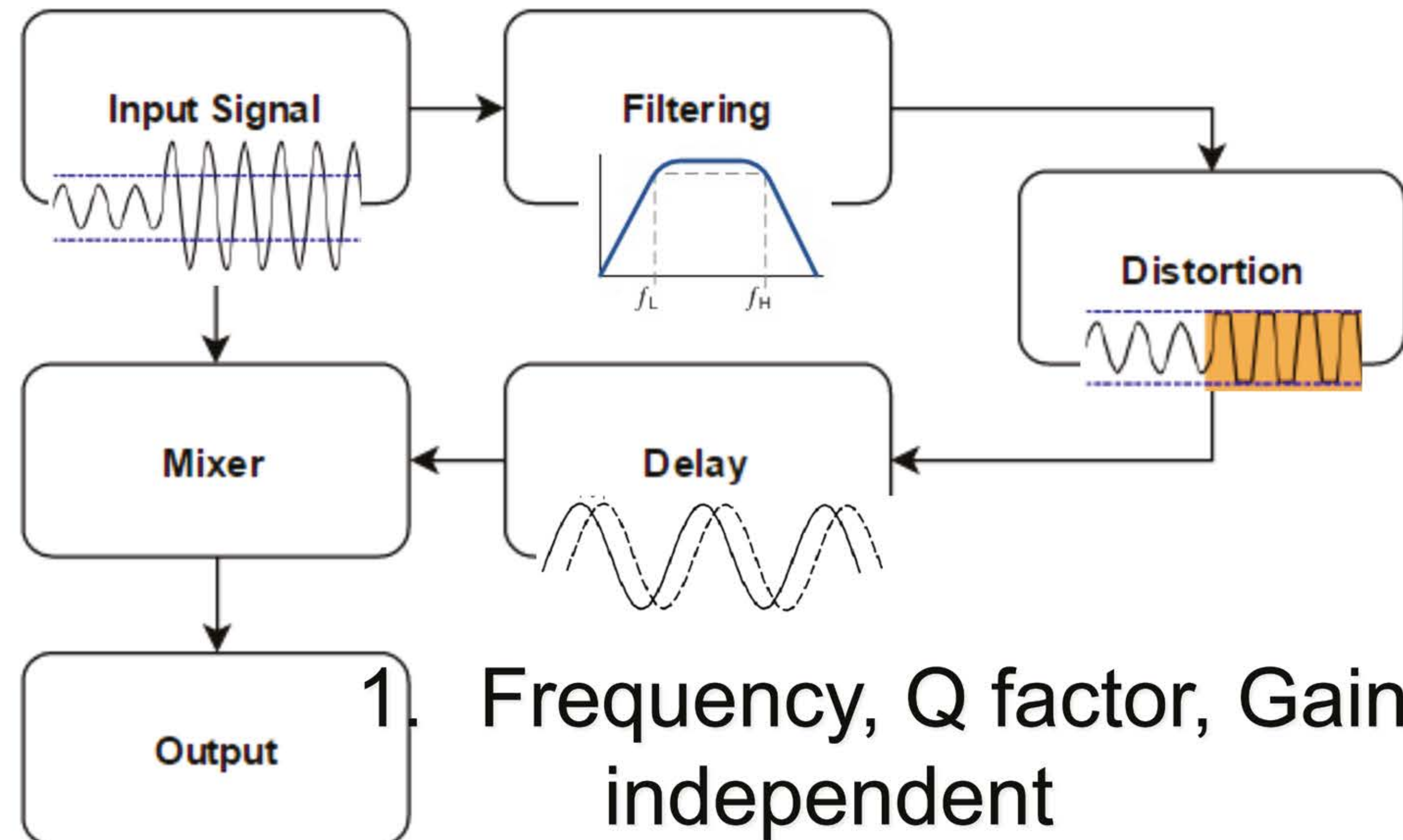- Band-pass Filtering
- MATLAB Simulation

Low Pass Feedback

V_{IN} → Summing Amplifier V_{HP} → RC Integrator V_{BP} → RC Integrator → V_{LP}

Band Pass Feedback

TL084 (Top View)

Kerwin-Huelsman Newcomb Filter

Objective :

Input Signal → Filtering → Distortion → Delay → Mixer → Output
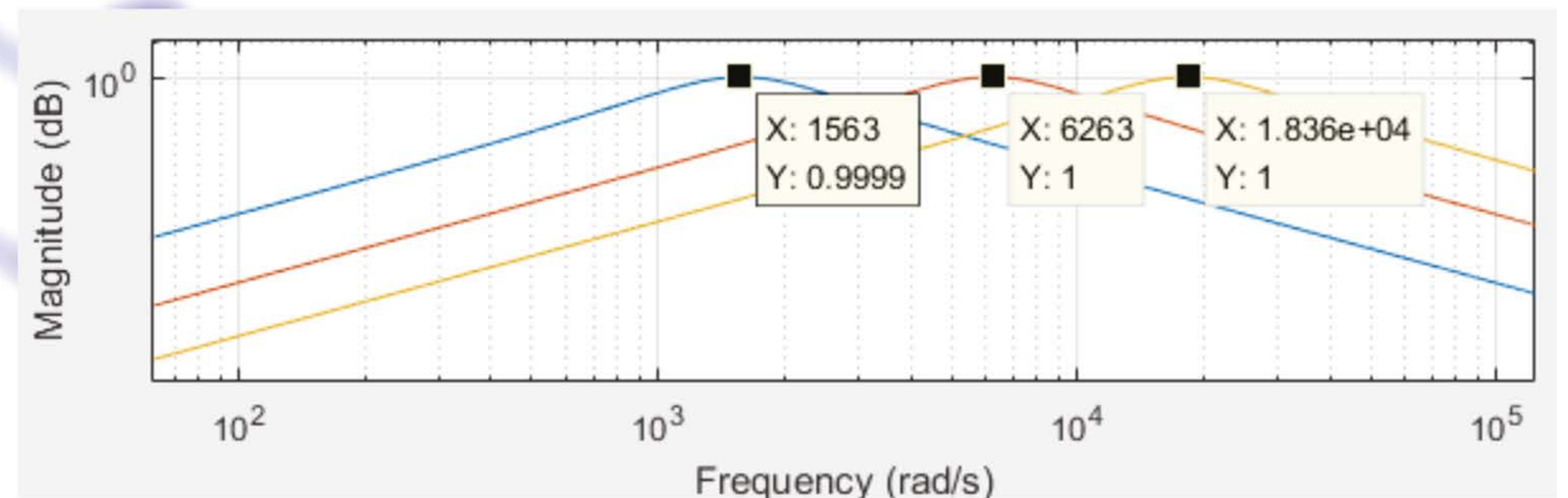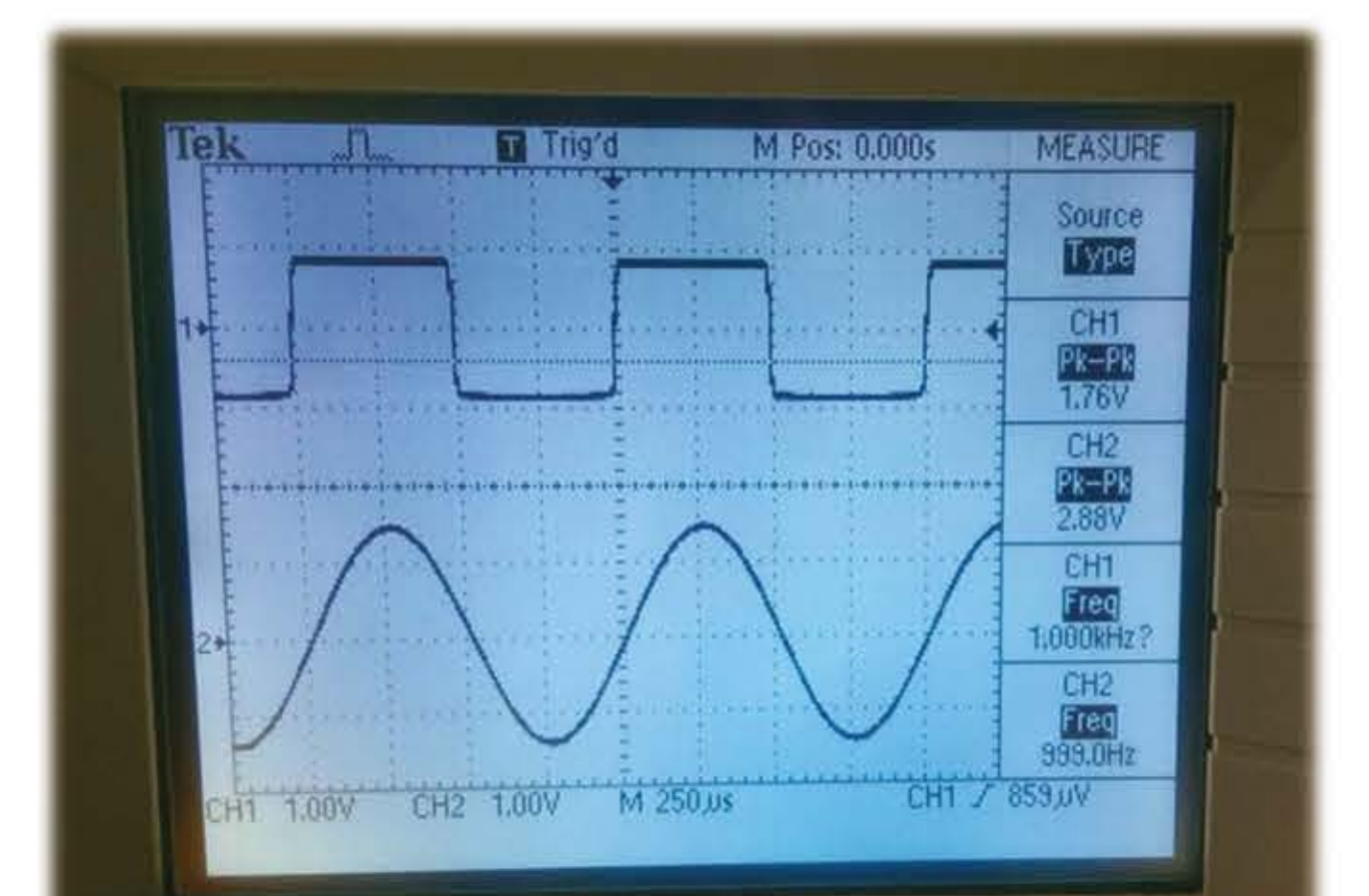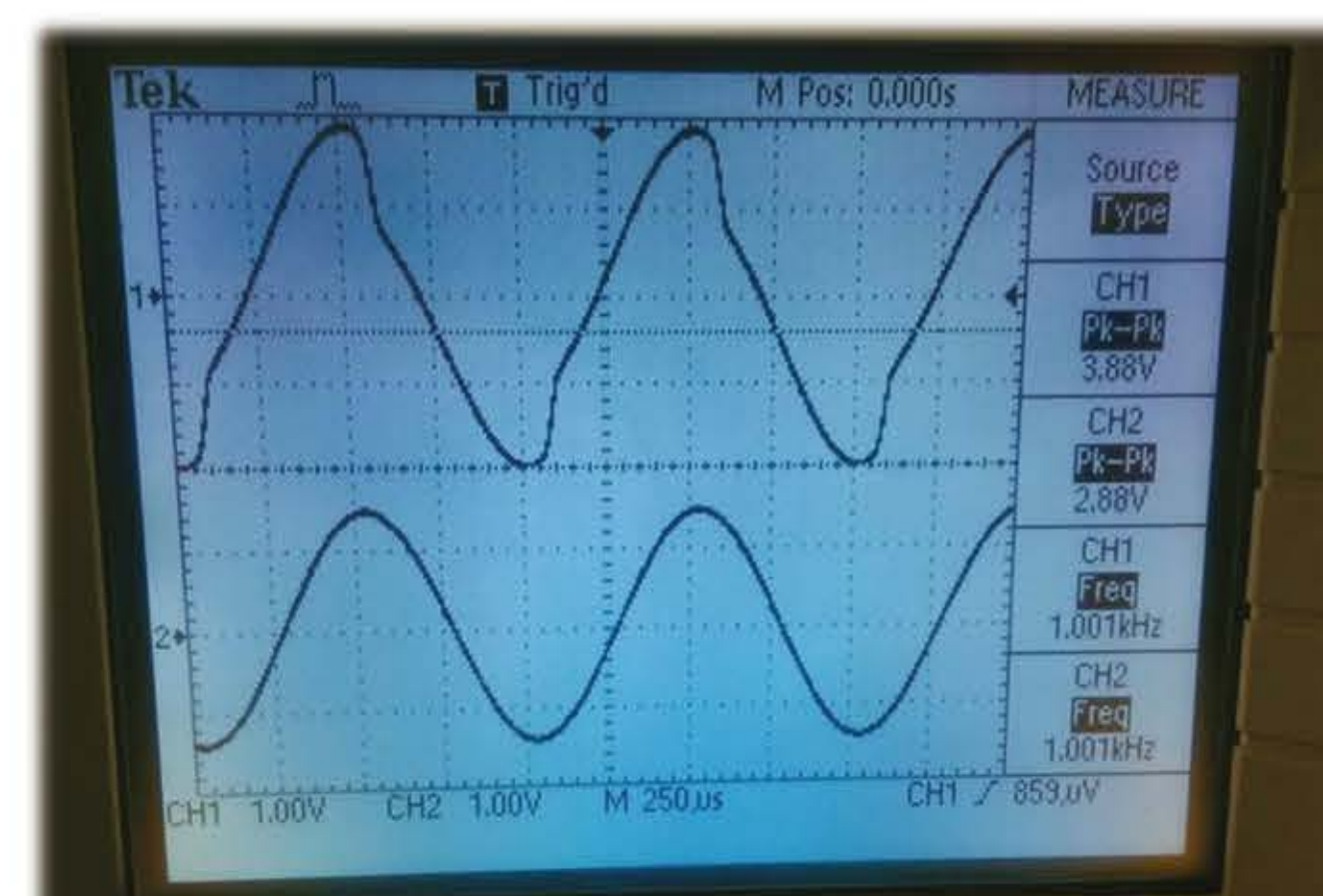
1. Frequency, Q factor, Gain independent
2. Gain & Attenuation (9dB ~ -9dB)
3. Flexible tuning in Distortion & Delay

Transfer function: a mathematical representation to describe inputs and outputs of system.

$$\frac{V_{BP}}{V_{IN}} = \frac{V_3}{V_1} = \frac{\frac{R_2}{R_1}\frac{1}{C_1 R_{f1}}s}{\left\{s^2 + \left[\frac{R_3}{R_3+R_4}\right]\left[1+\frac{2R_2}{R_1}\right]\left(\frac{1}{C_1 R_{f1}}\right)s + \frac{R_2}{R_1}\left(\frac{1}{C_1 C_2 R_{f1} R_{f2}}\right)\right\}}$$

X: 1563 Y: 0.9999
X: 6263 Y: 1
X: 1.836e+04 Y: 1

Magnitude (dB) vs Frequency (rad/s)

Frequency response: a measurement to describes the relationship of frequency and signal output level. A theoretical result is made as a reference for further experiment.

Result :

X: 1571 Y: 1
X: 6283 Y: 1
X: 1.885e+04 Y: 1.02

Magnitude (dB0) vs Frequency (rad/s)

Finally, performers are able to adjust the balance and effects of the sound.

Soft clipping and hard clipping are provided at the distortion.

Ch1	170Hz	RQ=2kohm	RdB=0ohm
Ch 2	1kHz	RQ=8.74kohm	RdB=10kohm
Ch 3	2.7kHz	RQ=12kohm	RdB=0ohm