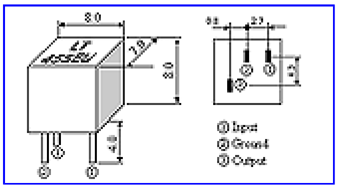
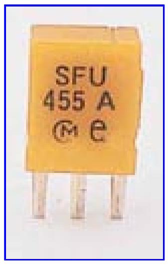
# Ceramic filter and resonators

This page investigates ceramic filters and resonators.
I will explain what a ceramic filter is and how you can use it.
All contribution to this page are most welcome



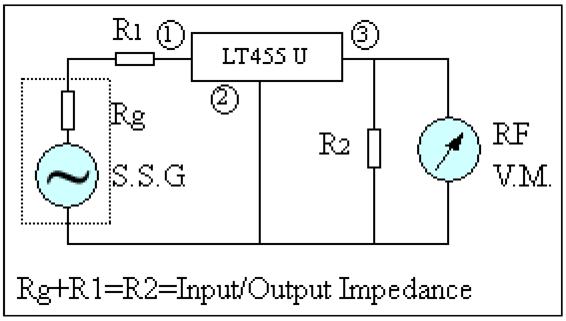



### Background

The ceramic componets are made of high stability piezoelectric ceramics that functions as a mechanicalresonator. The frequency is primary adjusted by the size and thikness of the ceramic element. Typical application includes TVs, VCRs, telphones, remote controls and radios.

### What is the main purpose to have a ceramic filter?

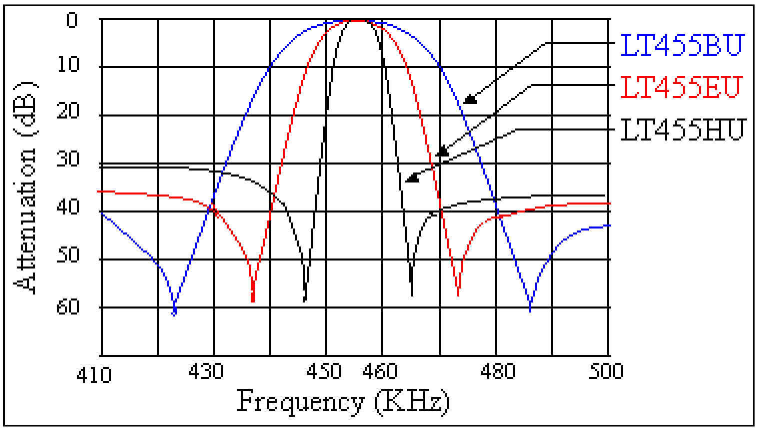
The filter is actually a bandpass filter with sharp filter characteristic. Figure at right shows a test rig for a 455kHz ceramic filter. At the input you have a signal generator and at the output you have RF voltmeter. The signal generator will sweep the frequency from 400kHz to 500kHz. There is some resistor to impedance match the filter.




Look now at the figure below wich shows the attenuation of the filter.

**dB conversion??** Attenuation in dB = 20*log (attenuation in times)
Example: 100 time attenuation give 40dB attenuation because 40dB = 20 * log (100)

This diagram show attenuation versus the frequency for 3 different type of ceramic filters. If we start to look at 455kHz, we can see that the attenuation is 0dB (no attenuation). Every signal wich is 455kHz will pass through the filter witout any attenuation. If the frequency is more or less than the 455kHz the attenuation increase. Look at the blue line. At 440kHz and 470kHz the attenuation has reached 10dB (equal to 3.16 times). The output signal (**RF V.M**) is only 31.6% of the input signal (**S.S.G**). The red line is dropping faster and at 440kHz and 470kHz the attenuation has reached 40dB (equal to 100 times). The output signal is only 1/100 of the input signal. The red ceramic filter is much sharper than the blue one.

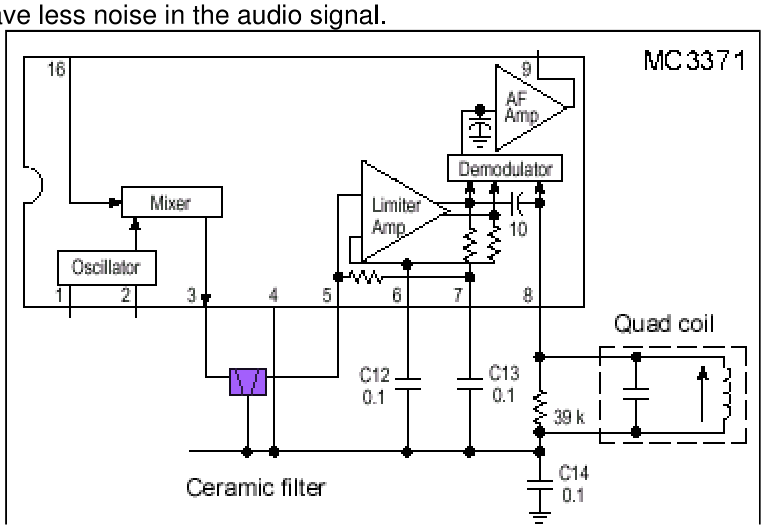



### Bandwith

The definition of the *BandWith* of a ceramic filter is the frequency gap where the signal has dropped less than 6dB. The blue line has +/- 15kHz bandwith and the red line has +/- 6kHz bandwith. The red line is sharper and dropps much faster.
There is filter with just a few kiloherts of bandwith. Lets say you have a FM-signal where the IF is 455kHz. The main signal is 455kHz modulated with the audio signal. Imagin the audio signal is +/- 20kHz then the total signal will be 455kHz +/- 10kHz. In such case you must use a wider filter to demodulate the total 20kHz. If you use a sharper filter you will loose the 20kHz bandwith of sound.
The advantage of a sharper filter is that you will have less noise in the audio signal.

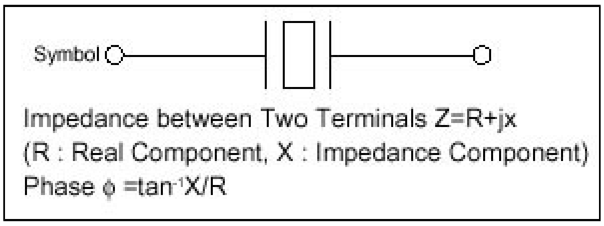
### Practical use of ceramic filter in a receiver

This receiver is MC3371. Pin 16 is the RF input to the mixer and pin1 and pin2 is the local oscillator. The product comes out at pin 3. Imagin you want to receive at 100MHz. The local oscillator is set to 100.455kHz and when the mixer mix the RF (100MHz) with the osc (100.455MHz) the product will be 455kHz and lots of other frequency products. What we want is only the 455kHz signal. And it is here the ceramic filter comes handy. It filter away almost everything except 455kHz +/- 10kHz.
The signal goes to pin 5 and limits and amplifyes. A FM-demodulator brings out the sound from the 455kHz signal with the help of a quad coil. The

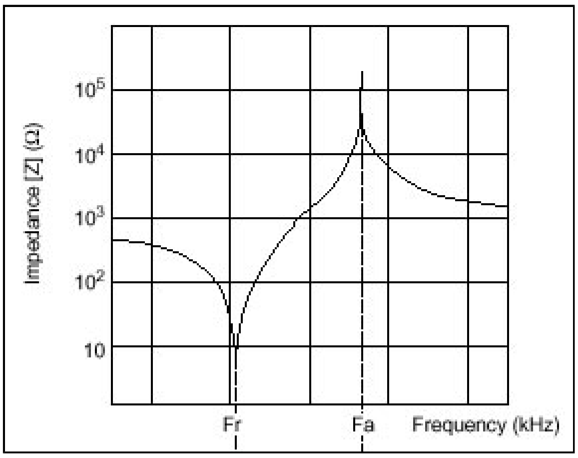


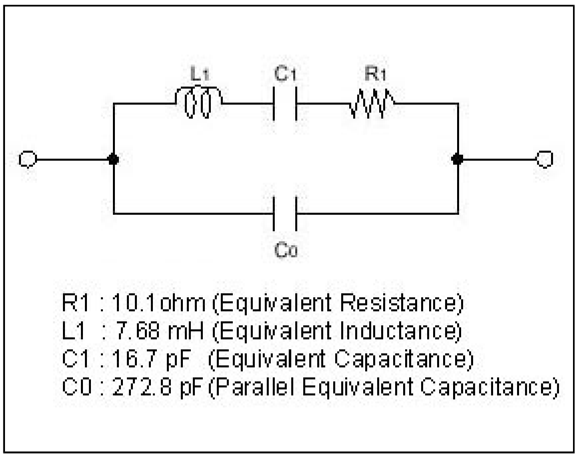
audio signal amplifyes and comes out at pin 9.

## Ceramic Resonators



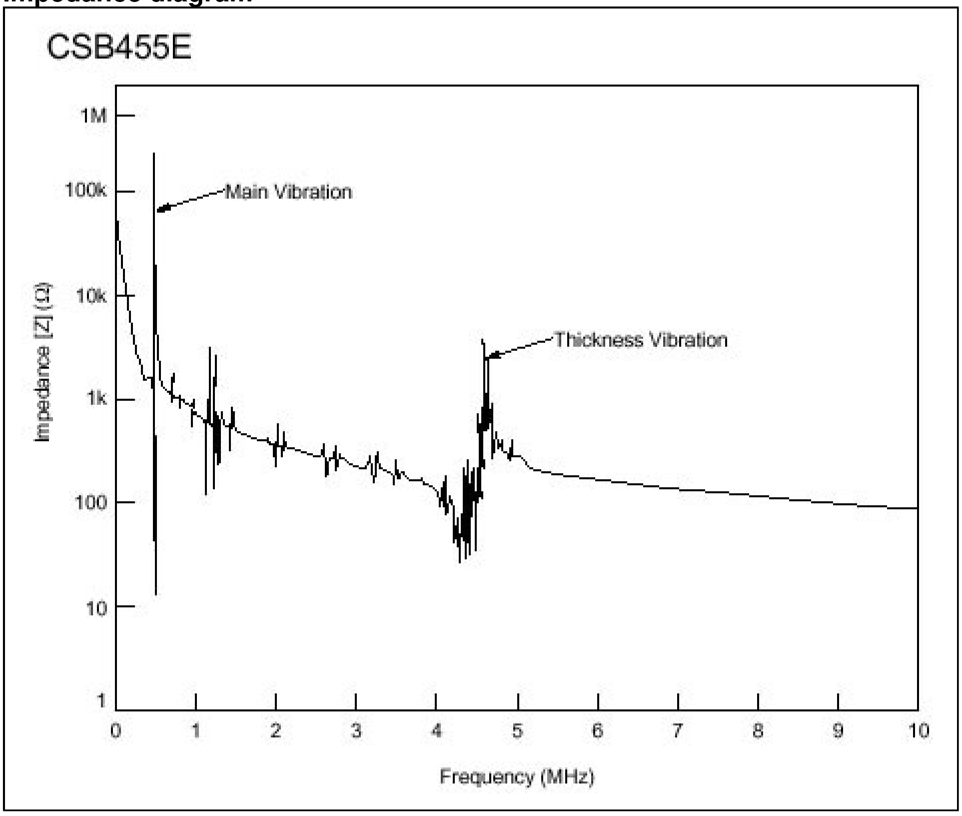

The ceramic resonator is mostly used as oscillator in different application. The ceramic resonator is often used instead of crystal because of it's lower price. The frequency accuracy is not as good as a crystal but in many application the accuracy is not critical. The ceramic resonator use the mechanical resonance of piezoelectric ceramics.(Generally lead zirconium titanate: PZT.) The figure at right shows the symbol for a ceramic resonator. The impedance and phase characteristics measured between the terminals are shown in figure below.



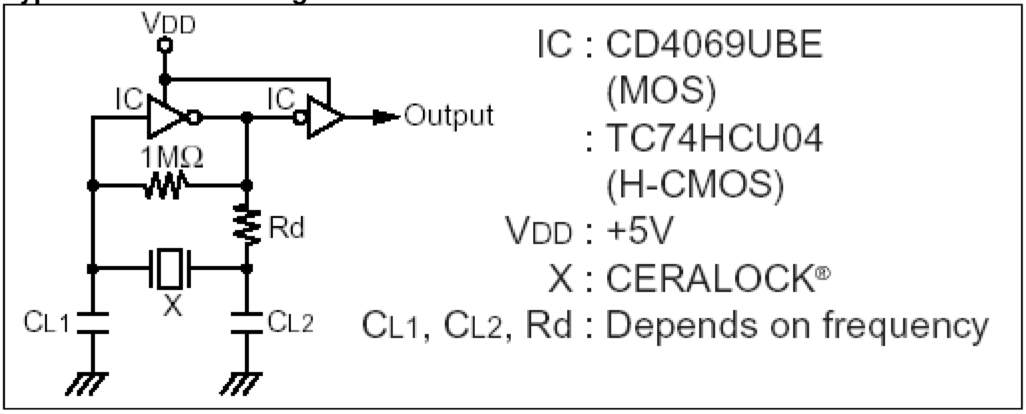

This illustrate that the resonator becoms inductive in the frequency zone between frequency **Fr** (resonant frequency), wich provide the minimum impedance, and the frequency **Fa** (anti-resonant frequency), wich provides the maximum impedance. It becomes capacitive in other frequency zones. This means that the mechanical vibration of a two-terminal resonator can be replaced equivalently with a combination of series and parallel resonants circuits consisting of an inductor **L** a capacitor **C** and a resistor **R**.

**Impedance diagram**



This diagram shows the impedans and frequency behavior in a 455kHz Ceramic filter. As you can see the main resonans is at 455kHz, but there are several other resonans frequency.

**Typical oscillator configuration with a ceramic resonator**




Well that was a small glimt about Ceramic filter and Ceramic resonators.

GO TO MENY

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