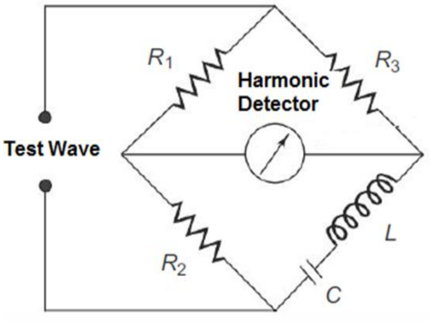
HARMONIC DISTORTION ANALYZER

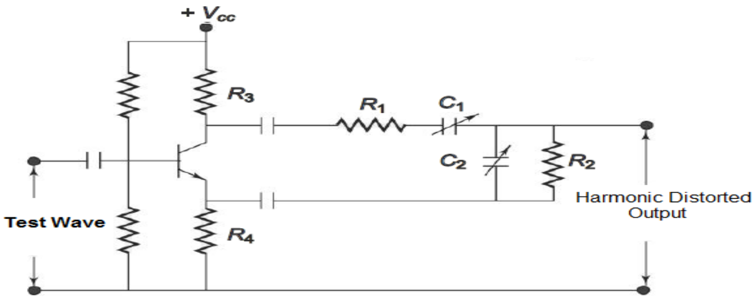
- The total harmonic power present in the test wave rather than the distortion caused by each component.
- The simplest method is to suppress the fundamental frequency by means of a high pass filter whose cut off frequency is a little above the fundamental frequency.
- This high pass allows only the harmonics to pass and the total harmonic distortion can then be measured.
- Three types of Harmonic Distortion Analyzer:
  - Resonance Bridge
  - Wein Bridge
  - Bridge T Network

Resonance Bridge



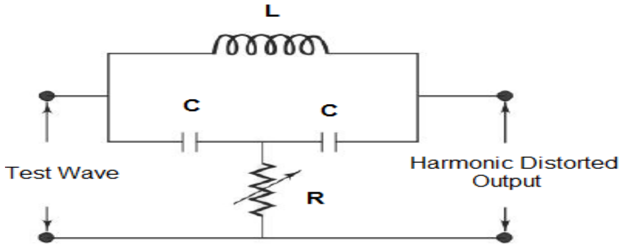
- The bridge is balanced for the fundamental frequency, i.e. L and C are tuned to the fundamental frequency.
- The bridge is unbalanced for the harmonics, i.e. only harmonic power will be available at the output terminal and can be measured.
- If the fundamental frequency is changed, the bridge must be balanced again.
- If L and C are fixed components, then this method is suitable only when the test wave has a fixed frequency.
- Indicates the rms value of all harmonics.

Wien's Bridge Method

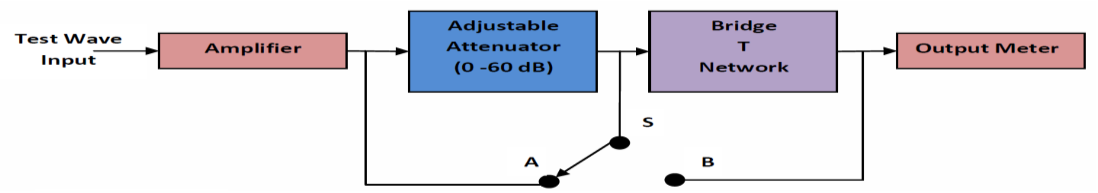


- Wien bridge arrangement: For continuous adjustment of the fundamental.
- The bridge is balanced for the fundamental frequency.
- The fundamental energy is dissipated in the bridge circuit elements. Only the harmonic components reach the output terminals.
- The harmonic distortion output can then be measured with a meter.
- For balance at the fundamental frequency, C1 = C2 = C, *R1 =R2 =R, R3 = 2R4·*

Bridged T-Network Method



- L and C's are tuned to the fundamental frequency, and *R is adjusted to bypass fundamental* frequency.
- The tank circuit being tuned to the fundamental frequency, the fundamental energy will circulate in the tank and is bypassed by the resistance.
- Only harmonic components will reach the output terminals and the distorted output can be measured by the meter.
- The Q of the resonant circuit must be at least 3-5.



- The switch S is first connected to point *A so that the attenuator is excluded* and the bridge T-network is adjusted for full suppression of the fundamental frequency, i.e. minimum output.
- Minimum output indicates that the bridged T-network is tuned to the fundamental frequency and that the fundamental frequency is fully suppressed.
- The switch is next connected to terminal *B, i.e. the bridged T-network is* excluded.
- Attenuation is adjusted until the same reading is obtained on the meter which indicates the total rms distortion.
- Distortion measurement can also be obtained by means of a wave analyzer, knowing the amplitude and the frequency of each component, the harmonic distortion can be calculated.

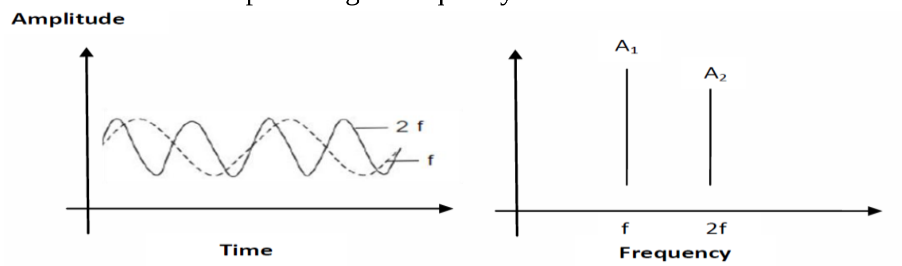
Advantages: Distortion meters based on fundamental suppression are simpler to design and less expensive than wave analyzers.

Disadvantage: Total distortion only obtained and not the amplitude of individual distortion components.

Spectrum Analyzer

Observing signals is to display them on an oscilloscope, with time as the *X-axis (i.e. amplitude of the signal versus time). This is the* time domain.

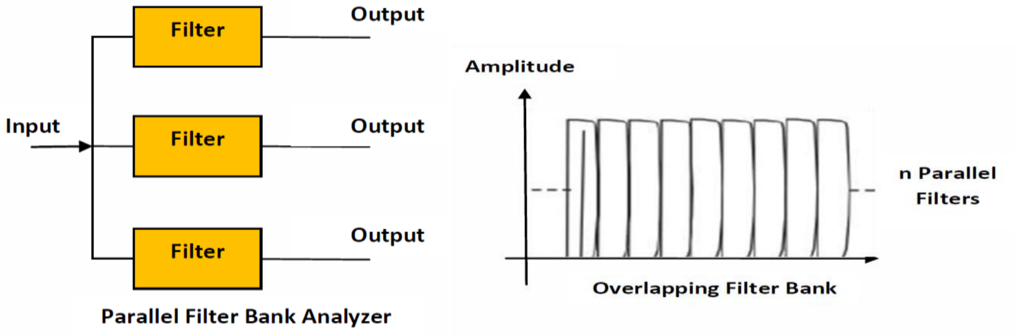
Spectrum analyzer: The instrument providing in frequency domain view.



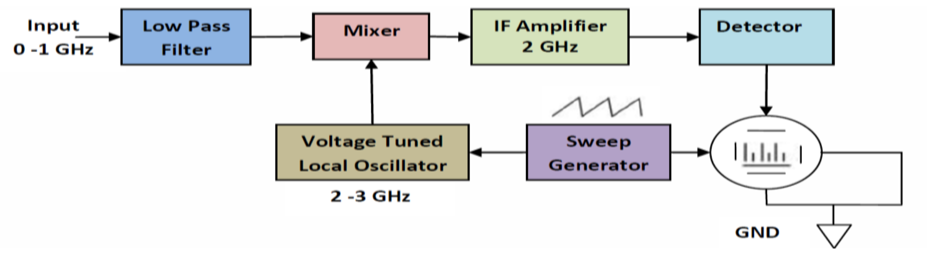
- A spectrum analyzer provides a calibrated graphical display on its CRT, with frequency on the horizontal axis and amplitude (voltage) on the vertical axis.
- Displayed as vertical lines against these coordinates are sinusoidal components of which the input signal is composed.
- The height represents the absolute magnitude, and the horizontal location represents the frequency.
- These instruments provide a display of the frequency spectrum over a given frequency band.

SPECTRUM ANALZER (Parallel Filter Bank Analyzer)

Spectrum analyzers use either a **parallel filter bank** or a **swept frequency technique**. In a parallel filter bank analyzer, the frequency range is covered by a series of filters whose central frequencies and bandwidth are so selected that they overlap each Amplitude other. Typically, an audio analyzer will have 32 of these filters.



RF SPECTRUM ANALYZER



- The frequency range covered by this instrument is from 1 MHz to 40 GHz.
- The basic block diagram is of a spectrum analyzer covering the range 500 kHz to 1 GHz, which is representative of a superheterodyne type.
- The input signal is fed into a mixer which is driven by a local oscillator. This oscillator is linearly tunable electrically over the range 2 - 3 GHz. The mixer provides two signals at its output that are proportional in amplitude to the input signal but of frequencies which are the sum and difference of the input signal and local oscillator frequency.
- The IF amplifier is tuned to a narrow band around 2 GHz, since the local oscillator is tuned over the range of 2 - 3 GHz, only inputs that are separated from the local oscillator frequency by 2 GHz will be converted to IF frequency band, pass through the IF frequency amplifier, get rectified and produce a vertical deflection on the CRT.
- **Spectrum analyzers are widely used in radars, oceanography, and bio-medical fields.**