

## TRIPLIN HARMONIC MITIGATION

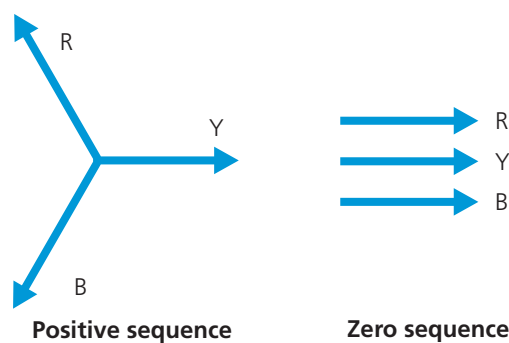
Triplen harmonics have frequencies in odd multiples of 3, i.e., 3<sup>rd</sup> harmonic (150 Hz), 9<sup>th</sup> harmonic (450 Hz), 15<sup>th</sup> harmonic (750 Hz) and so on. These harmonics have some peculiar characteristics, which make them very difficult to handle and mitigate. This article explains about the basics, sources, effects and mitigation techniques of triplen harmonics.

### Sources of Triplen Harmonics

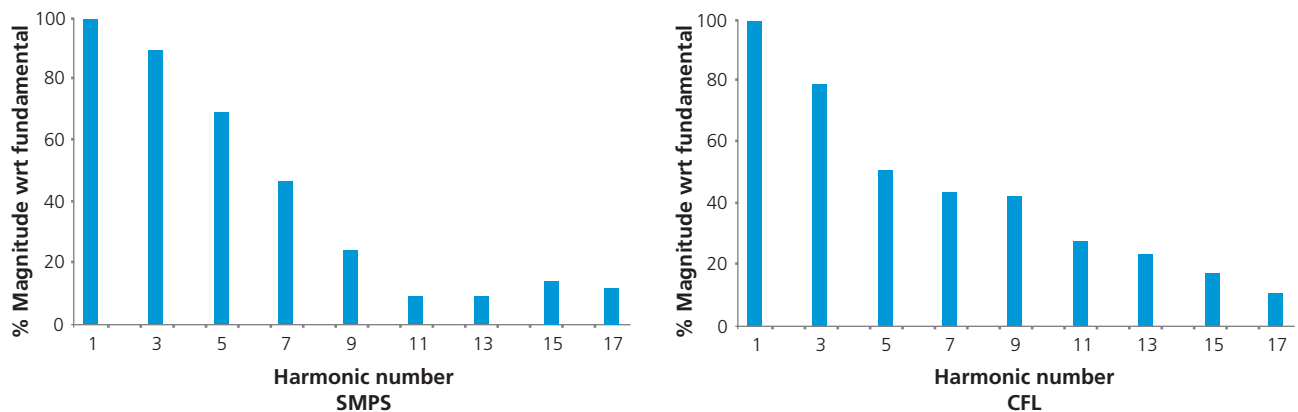
Triplen harmonics are usually generated by single phase non-linear loads that share a common neutral. Some of them are,

- SMPS in computers, televisions, etc.,
- CFL lamps
- Electronic dimmers and so on

These types of loads are common in IT parks, office, hospital and other commercial buildings. Following are the typical current harmonic spectra of SMPS and CFL lamps, where third harmonic is predominantly high.



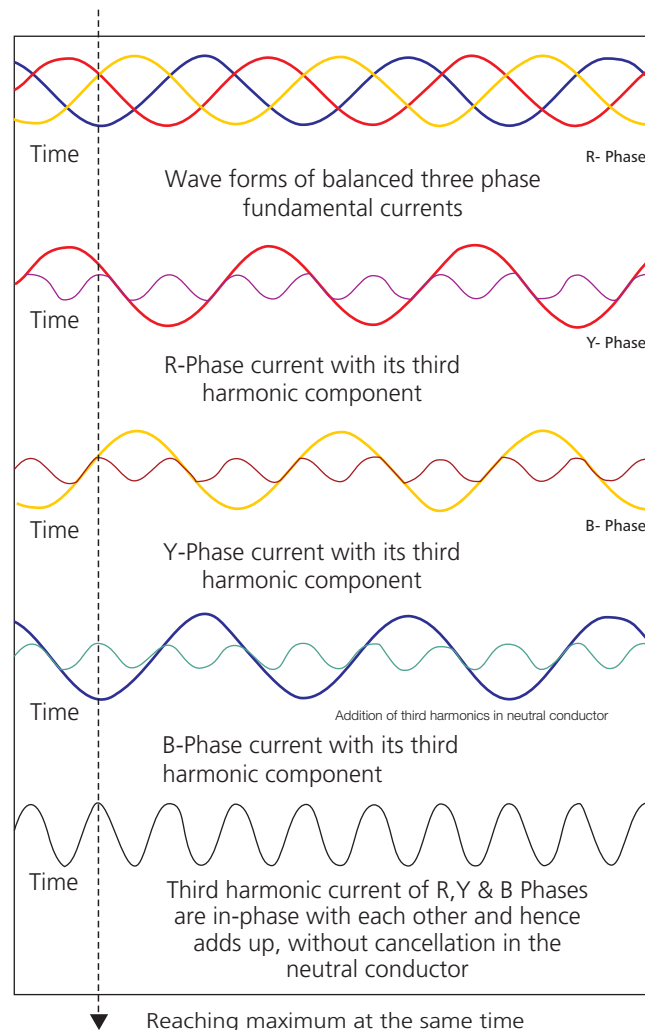
Neutral current is the vector sum of all the three phase (120° phase displaced) and the sum is zero, if the loads are balanced in all the three phase. But the presence of triplen harmonics will result in the flow of neutral current, even if the loads are balanced. This phenomenon is explained below:



All the triplen harmonics are zero sequence in nature and they are exactly in-phase in all the three phases, whereas the fundamental component (50 Hz), has positive phase sequence, displaced by 120° between the three phases.

The accumulated neutral current, because of the additive triplen current, can go up to 200% of the phase current.

## Three Phase System



## III Effects of Triplen Harmonics

- The harmonics accumulate in neutral and cause hot neutral or neutral burning due to neutral over-loading. Thus, we need to use a higher sized cable for neutral
- Distribution transformer over heating
- Busbars and cable overheating due to skin effect
- Eddy current losses (as eddy current is proportional to square of the frequency)
- Reduced life of electrical equipments like transformers, power capacitors, switchgear, etc.

## Triplen Harmonic Mitigation

Most commonly used passive filter for triplen harmonics is 14% detuned filter. This filter has the tuning frequency of 133 Hz, which is below the 3<sup>rd</sup> harmonic (150 Hz). This filter is very effective in averting the harmonic amplification of 3<sup>rd</sup> harmonics & above and thereby protecting power capacitors and other equipments. But detuned filter does not eliminate the harmonics completely. In order to achieve that, active harmonic filters with three-phase four-wire configuration should be used.