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BUSBAR SYSTEM

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1. Busbar General Profile.

The development of High-Performance Buildings (HPBs), from data and manufacturing centres to high-rises and hospital, requires flexibles, efficient and intelligence electrical power distribution. The Busbar System, based on the arrangement of rectangular bars known as “paired-phase”, has proved to be the best alternative to feeding the electricity structure of commercial, residential and industrial buildings with three-phase AC up to 600 volts maximum.

About three-phase current distribution, rectangular busbars are preferable to cylindrical conductors, because of the greater proximity of the conductor's centres, which minimises the loss of power transmission. Figure 1 shows the most elemental arrangement of busbars for AC current in a balanced three-phase system:

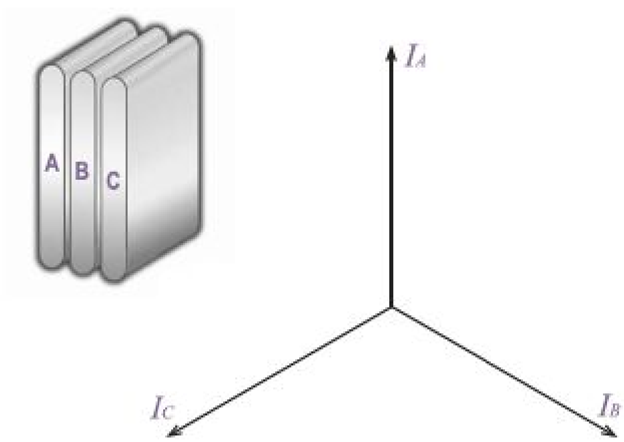

Figure 1. Basic Busbar arrangement in a balanced three-phase system.

This basic arrangement has drawbacks, however. First place, it generates an unbalanced condition of voltage drop as a result of the less power-loss in Bar B, a consequence of the proximity effect. Being that there is no cancellation of the magnetic field, the losses by cause of the skin effect constitute the second unwanted issue. The current density is higher in a specific region of the conductor. That means possible damages because of the increase of temperature on that site.

To minimise the magnetic field and the proximity effect, two bars are used by each phase in the paired-phase arrangement. In Figure 2, phase C pairs with the phase A. Phase A pairs with the phase B, and phase B pairs with the phase C.

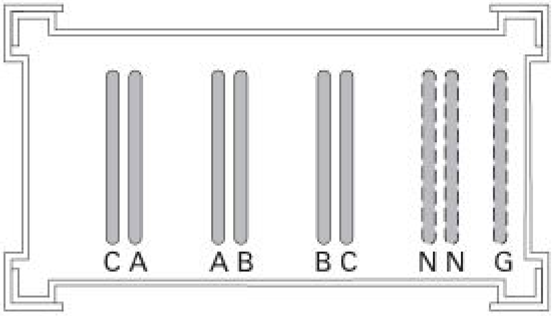

Figure 2. Two bars by each phase in the paired-phase arrangement.

Busbars are grouped in pairs so that the current in each pair is almost equal in magnitude but opposite in direction. Thanks to that, the reactance is lowered to a minimum. Figures 3 and 4 illustrate how this grouping is accomplished in a balanced three-phase system, expressing every phasor as the sum of two vectors, or dividing physically every current into two sub-currents of similar magnitude, then pairing this sub-currents with those from another phase, according to Figure 2.

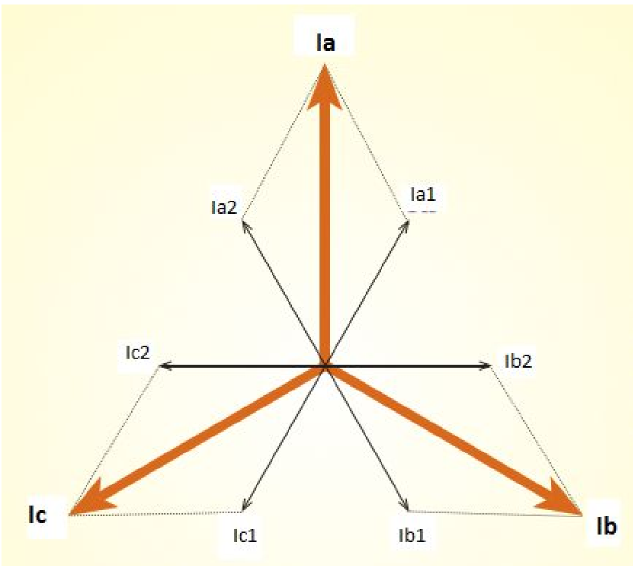

Figure 3. Every current phasor is formulated as the sum of two vectors.

Figure 4. Every current is divided into two sub-currents. Then, the paired-phase system is accomplished.

Obtaining the minimum possible impedance is a core benefit from implementing the paired-phase system. In consequence, it is feasible to achieve maximum efficiency in power transmission. Other great advantages are the low balanced voltage drop, even in the case of an unbalanced load; the temperature in every section of the bar and in every bar is the same.

Next sections will deepen the mathematical analysis of the paired-phase system:

2. **Extra Losses caused by skin and proximity effects.**
3. **Impedance of three-phase rectangular Busbar System.**
4. **Power transmission benefits of the paired-phase arrangement in a three-phase Busbar System.**