Balanced and Unbalanced Single Wire

Michael Bank
Jerusalem College of Technology (JCT), Jerusalem, Israel

Abstract— Reactive power in balanced and unbalanced lines constitutes the main problem that is examined in this article. We will describe a balanced line as a line with differential input and output signals. Unbalanced lines, such as the SWER scheme, have to cope with the reactive power problem. However, this problem does not exist in the one wire balanced B-Line scheme. In addition, various methods of grounding for potential zeroing are proposed.

Keywords—one wire, single line electricity, SWER system, MB antenna

I. INTRODUCTION

Over the past 40 years there have been major changes in the understanding of the processes of electrical systems [1 – 3]. Presently, many experts in the field believe that there is no such phenomenon as electrical current. A wire is not a pipe within which something flows. On the one hand, electrons move slowly, but, on the other hand, the energy is transmitted at the speed of light. It is, therefore, more logical to assume that electrical energy is transmitted in the form of potential along the surface of the wire. This explains the presence of the “skin effect”, which, apparently, was the basis of the single-ended method proposed by Tesla. Clearly, the concept of the electrical current is convenient for analyzing electrical circuits. Likewise, it is convenient to use the concept of negative frequency in spectral processing of signals.

Inside the ground, current cannot flow. In case of using good grounding (for example standard protection grounding), then potential of point in ground input will be zero. However, between two zero potentials, no current can flow. If there are two potentials where grounding is not good, then there is a very high resistance between them. However, thanks to zeroing of potential, it is possible to ensure the flow of current in one wire as it occurs in the SWER system and in the proposed B-Line system [4 – 6]. Consequently, there are some changes in the understanding of the use of unbalanced lines for transmitting electrical signals.

II. BALANCED AND UNBALANCED LINES

Figure 1 illustrates the normal construction of balanced and unbalanced lines. Balanced lines are used mostly for transmitting information signals. This allows decreasing noise influence and interferences [1].

III. GROUNDING IS POTENTIAL ZEROING

In properly made protective grounding, the current flowing inside the ground is absorbed and cannot flow beyond 10 - 20 m (see Figure 2).

In the electronic and electrical schemes theory, a "ground" is usually ideal sink, which can absorb an unlimited amount of current, while the ground point potential is zero [2].

In addition, let us remind the exciting fact that the linear resistance of ground between two slightly grounded points is 50 - 1000 Ohms per meter (or higher). This is not comparable with the resistance of the wire. As a result, energy cannot be transmitted between two points through the ground. However, grounding can help transmitting energy through one wire. Grounding points have zero potential, meaning that the between two zero points cannot be a channel for transmitting current (See Fig 3).
This unbalanced line must transmit all energy and all signals from Tx to Rx. But this is a problem because of the following reasons: potentials of grounding points are the same and constant (zero). However, potentials in points A and B in Fig. 3 are different due to a signal delay. This means that they have different phases. This situation resembles a reactive load problem. In the reactive load case, there is a reactive energy, namely, the source must produce active and reactive energy. In other words, in the case of long lines, this system loses a large amount of energy. The problem of the appearance of reactive power in unbalanced schemes is well known [3]. This statement can be illustrated by the example of the SWER system.

IV. ABOUT SWER SYSTEM

The authors of this system claim that their system (see Fig 4) uses as electricity distribution method that makes use of only one conductor as well as the return path through earth [4].

Cos $\varphi = 0.08$ for distance 30 km. However, these Cos $\varphi$ values are correct for this constellation only. If a current increases, then the load resistance decreases and Cos $\varphi$ increases.

Here, it is clear that the generator must produce a current that is greater than the current in the load. This problem cannot be solved by means of compensation using series or parallel inductors or capacitors, since the phase shift of these filters depends on the value of the resistive load which, in its turn, is not constant. These filters have large attenuation which considerably complicates the possibility of compensating for the phase shift. In case if Figure 5 difference between source and load power equals 9 dB.

V. BALANCED ONE WIRE (B-LINE) SYSTEM

The author proposes a new single-wire system (B-Line) [4]. The idea of B-line method is as follows. Take two-wire line or three wires of three phase lines. Set equal phases of current in all wires, with the help of a phase shift devices. Thereafter, the wires may be combined into a single wire. Prior to load, this single wire should be split into two or three wires, with the required current phases in each wire. The generator in the B-Line scheme produces exactly the same two currents as in the usual balanced two-wire circuit. For this reason, B-Line scheme can be considered balanced. Figure 6 illustrates the scheme and results of the simulation of a B-Line system for comparison with the results of the SWER system (see Figure 5).

In the case of B-Line, the current of generator almost equals to the current in the load.
Grounding in B-Line is used for zeroing purposes only. However, zeroing can be achieved by other methods. For example, in two B-lines with opposite phases, one can combine both points designed for zero potential. In this case, there is no need in grounding [5]. For simulations, one can use another zeroing method: combining the required points with the help of a half wavelength line, i.e. combining of existing and opposite potentials. This is illustrated in the receiving part of the simulation scheme in Figure 6a.

The selected parameters of the delay line correspond to needed current phase shift in load input.

VI. BALANCED MONOPOLE

B-Line method can be used on any frequencies (including DC), with any voltage and power. For example, B-line idea was used to build the transceiver without antenna (MB antenna) with printed circuit board as radiation element (see Fig. 7). One can view it as a balanced monopole [7].

VII. CONCLUSION

There are substantial advantages of B-Line scheme in its ability to transfer a differential (balanced) signal by a single-wire. In addition, the role of grounding in electrical systems causes controversy and doubt. We hope that the above explanation helps eliminating stumbling blocks.

REFERENCES

[6] www.youtube.com/watch?v=AMW6fVERQ0k