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Power Conversion Distribution System Using a Resonant High-Frequency AC Link.

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Summary:

Static power conversion systems based on a resonant high-frequency (HF) link offers a significant reduction in the size and weight of the equipment over that acheived with conventional approaches, especially when multiple sources and loads are to be integrated. A faster system response and absence of audible noise are the other principal characteristics of such systems. This paper proposes a new conversion configuration based on a HF link which is suitable for applications requiring distributed power, Fig. 1

The single-phase resonant link, which operates at a fixed frequency above the audible range, performs the dual function of power distribution and temporary energy storage. Component converters are proposed that can operate efficiently from the high frequency in order to interface various sources/loads to the link. A common characteristic of these converters is that all switching instances are restricted to the zero crossing points of the link voltage. This prevents the switching losses from becoming prohibitively large, as they would if conventional techiniques of phase-angle control for ac input and PWM for dc input are used at these elevated frequencies. In operation with restricted switching, therefore, the low-frequency signals are synthesized by using half-cycles of the HF voltage as the basic unit of synthesis. A process of pulse-density modulation (PDM)

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is used to control the amplitude of the fundamental component of the synthesized signal in accordance with a reference signal. In this manner, fixed or variable amplitude dc and fixed or variable frequency ac signals (current or voltage) of single- and three-phase type can be synthesized (Fig. 2) from the fixed frequency, single-phase ac voltage of the link. In spite of the restriction on the switching instances, it is shown that the harmonic distortion in the signals synthesized by the PDM converters remains low because of the large frequency differential that will typically exist in a HF link system.

Computer models of the individual components of the proposed system have been developed to obtain better understanding of their operation and to study the overall system behavior. A laboratory breadboard will be used to experimentally verify the validity of the computer simulations. The data from the breadboard will also be used to project efficiency and the economic feasibility of the proposed system.

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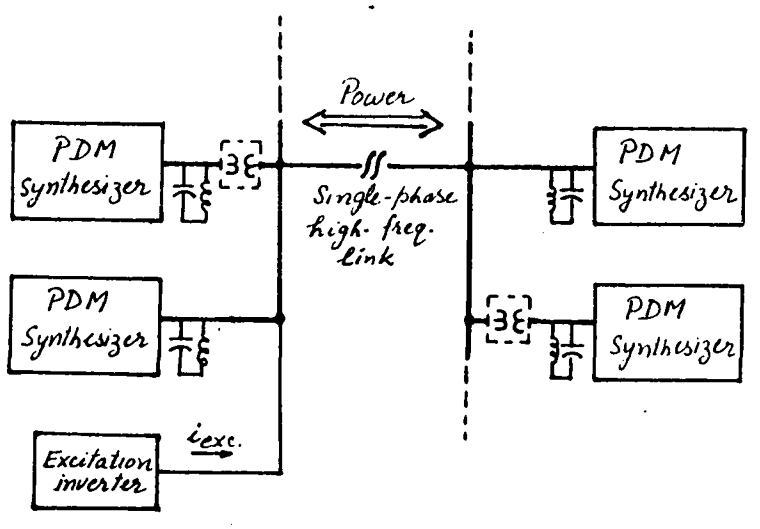

Fig. 1 Proposed HF-link based static power conversion system.

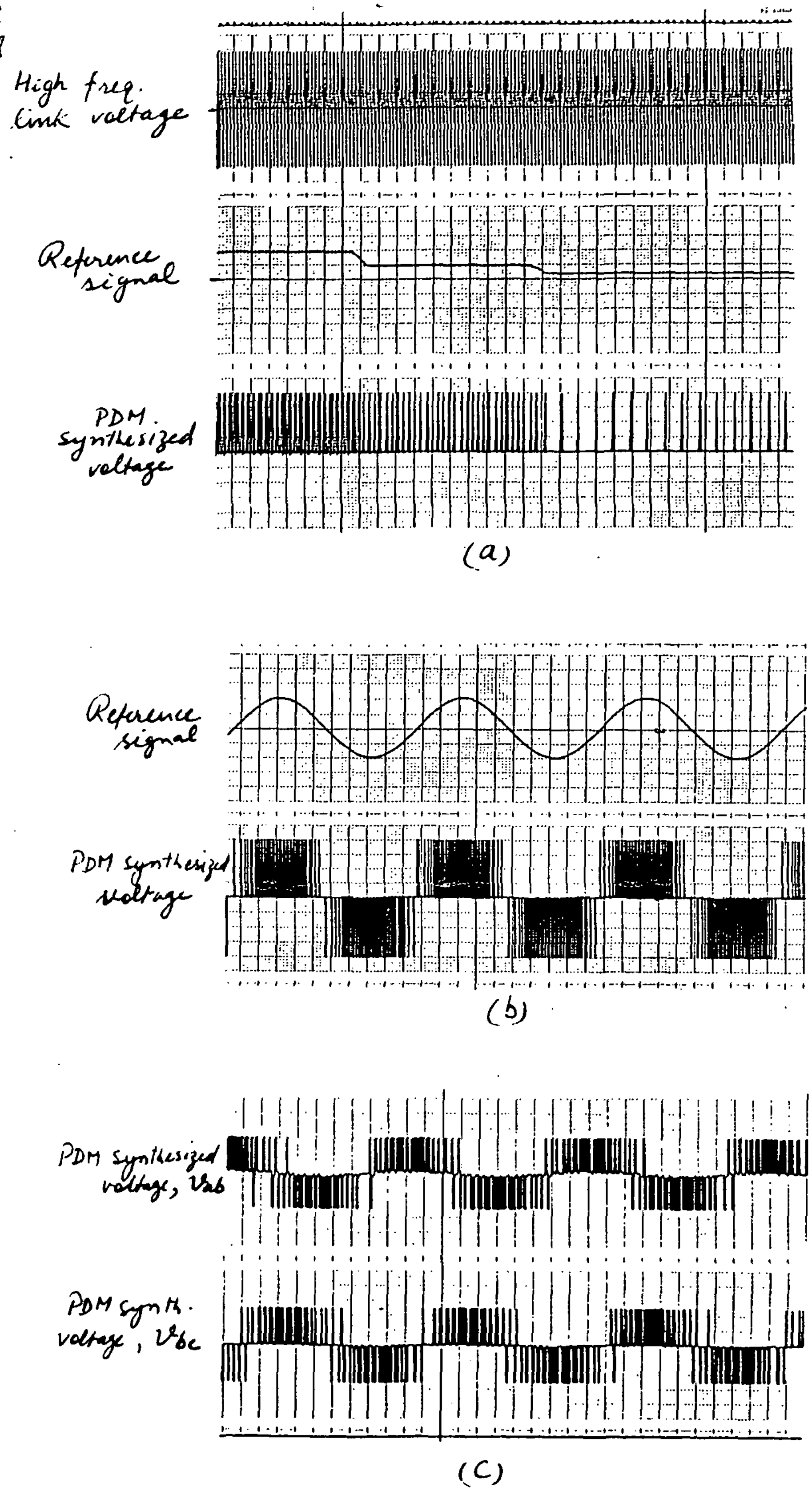

Fig. 2 Pulse-density-modulated (PDM) synthesis of dc and ac voltages. (a) dc. (b) Single-phase ac. (c) Three-phase ac.