

Sequential Quarter-Wave Transmission-Line Transformers

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Abstract

A recent paper [C. E. Baum, "Nonuniform-Transmission-Line Transformers for Fast High-Voltage Transients", Circuit and Electromagnetic System Design Note 44, 2000] considers a quarter-wave transmission-line transformer for improving the matching of a switched oscillator to an antenna with an input impedance in the 100Ω range. There it was observed that a significant increase could be made in the peak voltage (or equivalently, peak power) delivered to the antenna. The stored energy in the switched oscillator is, of course, then delivered in a shorter time while still approximately maintaining the basic oscillator frequency.

In stepping up the voltage delivered to the antenna we have the associated problem of insulating the antenna input so as to withstand the higher voltage. Perhaps it would be better to step up the voltage in a more gradual way so that as one progressed away from the reflector focus and the feed arms became farther apart the voltage could be allowed to be larger without breakdown. As we shall see, this is accompanied by an increase in the transmission-line characteristic impedance as one progresses away from the switched oscillator.

A sequence (cascade) of quarter-wave transmission-line transformers can then have some advantages over a single transformer. The voltage is allowed to more gradually increase through the sequence, potentially giving better insulation characteristics in some applications. In the limit of a large number of cascaded transformers the ensemble gives a version for discrete frequencies comparable to a continuously varying transmission-line characteristic impedance as used for a pulse transformer.