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A Fully Symmetric Waveguide-Cavity Microwave Pulse Compressor

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Abstract

In order to preserve electromagnetic symmetry during the charging cycle, a differential two-waveguide cavity is considered.

1. Introduction

A recent paper [2] summarizes various design-feature possibilities for microwave pulse compression for weapon and test facility use. Emphasis there concerns a single-ended type of source in which a cavity waveguiding structure is fed by an iris to ring up the cavity. At one end there is a switch to change the case of negligible coupling to the output guide to the case of maximum coupling.

As discussed there, the switch is near the output port to maximize symmetry by making the difference between incident and reflected waves as small as practical. The present paper considers a two-cavity differential system to maximize this symmetry.

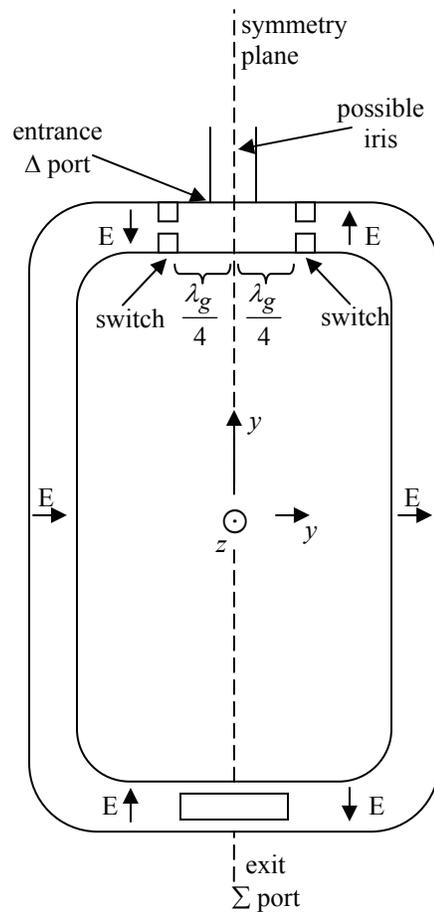
2. Symmetrical Differential Waveguide Cavity

As illustrated in Fig. 2.1, let us consider the yz plane as a symmetry plane, about which the fields are antisymmetric [3] during the charging cycle. The antisymmetric fields enter at the top from a rectangular waveguide in what would be the Δ port of a magic tee with an appropriate inductive iris (also maintaining symmetry). At the bottom there is the Σ port into a rectangular waveguide for which the lowest order (only propagating) mode has *symmetric* fields. If the symmetry is perfect there will be *zero* coupling to the output, even including the effect of resistive wall losses.

As discussed in [1], such a differential system needs to impedance match the waves into the output guide after a switch closes to make the waves add (be symmetric) at the output. The output waveguide can have half the height to achieve this (for half the impedance of the cavity guides). Alternately, one can install a quarter-wave (or other-type) impedance transformer in the output waveguide.

3. Switching

Continuing the symmetry, Fig. 2.1 shows two symmetrically positioned switches so as to maintain the symmetry during the cavity-charging cycle. In this case only one is closed to shift the reference zero electric field a quarter guide wavelength to right or left (perhaps alternately for higher repetition rate). One of the two switches can be command triggered, or can be let self break for higher power. In the latter case it might be a statistical question of which switch triggers for each microwave pulse (noting the unavoidable tiny asymmetries).



– possibly connected to quarter-wave transformer.

Fig. 2.1 Antisymmetric Field Distribution During Waveguide-Cavity Charging.

4. Concluding Remarks

Now the symmetry allows the switches to be at the opposite ends of the waveguides from the common output. This is in contradistinction to the result in [2] for a single waveguide.

So now we have some advantages of a differential waveguide system. Of course there are disadvantages in the increased complexity.

References

1. C. E. Baum, "Impedance-Matched Magic Tee", Circuit and Electromagnetic System Design Note 51, March 2006.
2. C. E. Baum, "Options in Microwave Pulse Compression", Circuit and Electromagnetic System Design Note 68, May 2010.
3. C. E. Baum and H. N. Kritikos, "Symmetry in Electromagnetics", ch. 1, pp. 1-90, in C. E. Baum and H. N. Kritikos (eds.), *Electromagnetic Symmetry*, Taylor & Francis, 1995.