Microwave Memos
Memo 22

Insertion of High Impedance at Output Switch to Reduce Loading on Oscillator Q
(extension of Microwave Memo 20)

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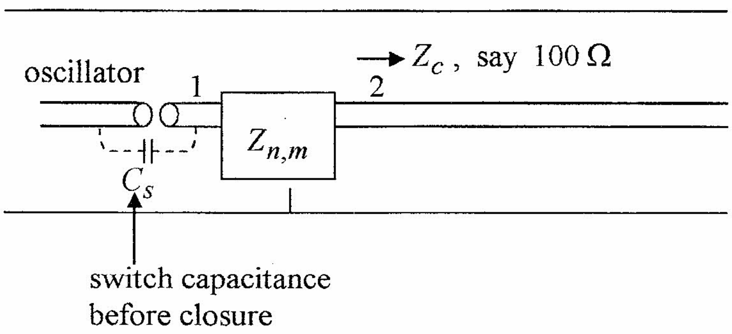
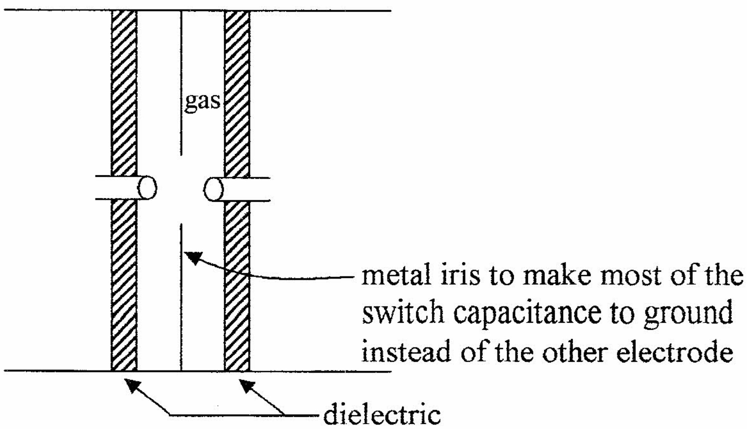


Think of a 2 port network, reactive, which puts no voltage on terminal 2 (loaded by Z_c) at f_0. When switch closes $\Rightarrow C_s$ is replaced by a short circuit. Then power is delivered to Z_c. Is this possible?

First minimize the switch capacitance by moving dielectrics away from arc position



Note that the iris capacitance needs to be included when designing a particular resonant frequency for the oscillator.

Depending on how small one makes the feedthrough via the switch capacitance, one might actively cancel this by feeding some power from the lower-power oscillator to the output side of the switch.

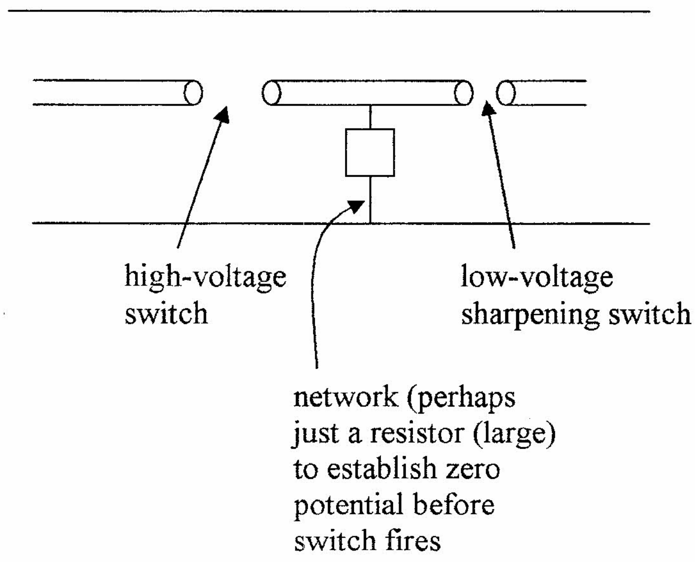
Note for, say, a 100 Ω transmission line the switch inductance L has a time constant

$$\tau = \frac{L_S}{Z_C}$$

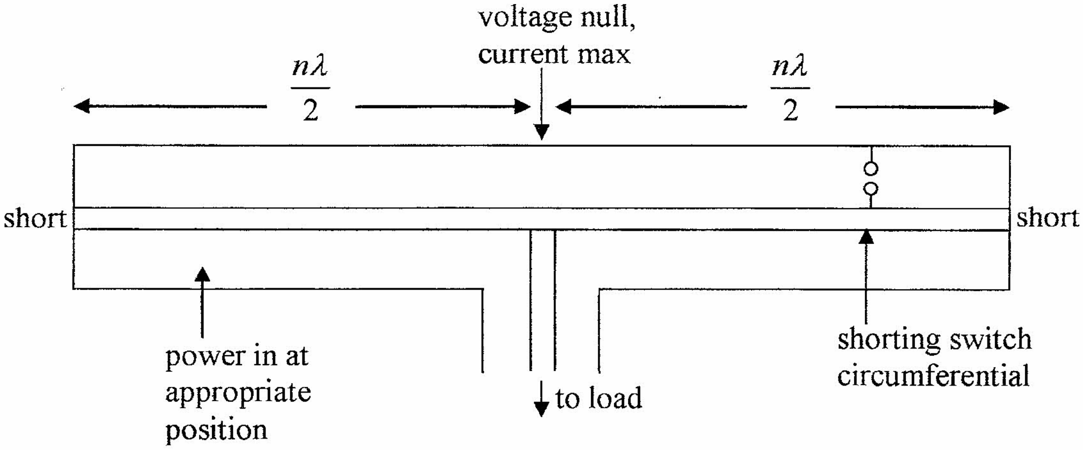
Which is smaller than that for a 4 Ω transmission line by a factor of 25.

So a 2nH gap has a time constant of 20 ps, or risetime of 40 ps. So one might get signals through it up to a few GHz. The pulse width or number of cycles is governed by the length of the oscillator. The lesser effect of the switch inductance may give some advantage over the switched oscillator.

Another approach would use 2 switches



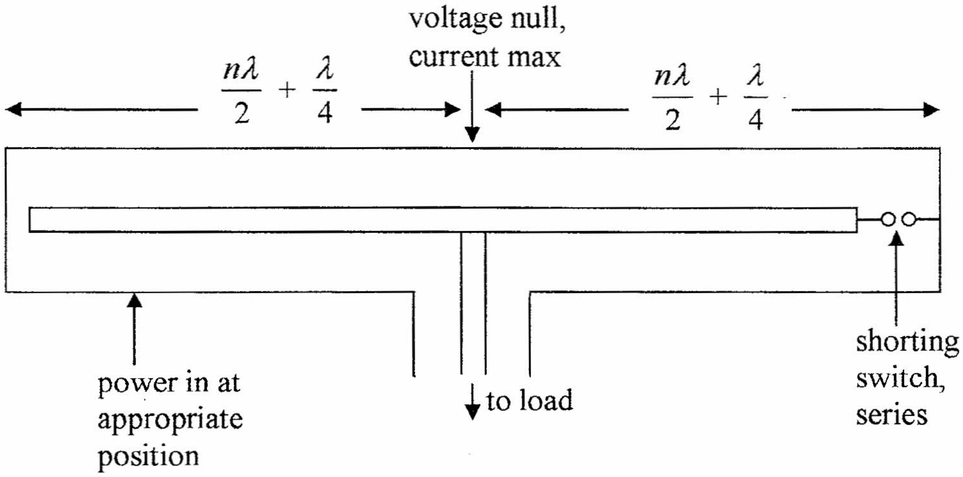
Another approach would take the energy out of the coax at a position of an appropriate voltage null. Then by quickly shorting the line at some new position by a switch, the original voltage null position is moved away from the output and power is delivered to the load.



Sliding contacts at ends can tune up the null position to allow for perturbation due to switch capacitance.

Note now there is no switch in series with the load. Any inductance in the shorting switch can be used to fine tune the switch position.

A dual approach might use a series shorting switch to change an open to a short circuit



When the switch closes the open circuit (+1 reflection) goes to a short (-1 reflection) changing the phase of the reflection and making the center go to a voltage maximum, thereby sending power to the load. For maximum transfer of power to the load we need $Z_c = 2\,Z_L$.

The left end can also be made a short by shifting its position a quarter wavelength.