Sensor and Simulation Notes

Note 145

General Principles for the Design of ATLAS I and II

Part III: Additional Considerations for the Design of the Terminations

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4 March 1972

1. Matching resistor distribution to TEM mode pattern

The considerations are similar to those for the pulser array discussed in Part I, section 15. The resistor strings can follow streamlines where the change in the stream function is the same between each string. Along each resistor string the resistance between equipotentials for the TEM mode should be proportional to the potential change with the same proportionality for all strings. Thereby equal currents will flow in each resistor string (ideally), and the electric and magnetic fields will match the TEM mode when averaged over the appropriate curvilinear rectangles if we ignore the wave on the back side of the terminator.

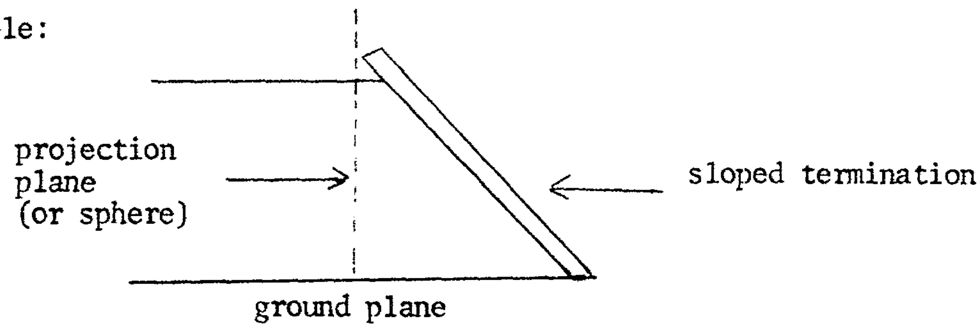
Of course there is a wave on the back side of the terminator but this is compensated by the inductance associated with the resistor spacing and any internal inductance of the resistors.

The terminator is then so far a distributed TEM mode LR terminator.

2. Sloping the terminations

This is discussed in SSNs 95 and 103.

example:



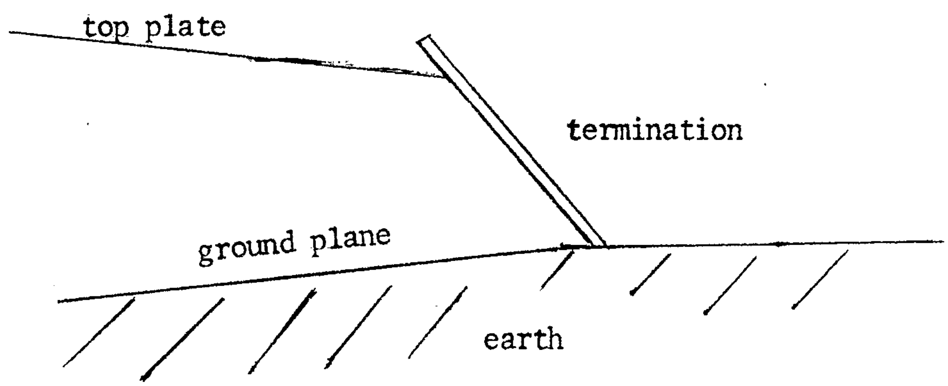
The sloped termination when projected onto the projection plane should meet the requirements for TEM distribution discussed in 1. Basically the direction parallel to the main electric field is stretched while that parallel to the main magnetic field maintains the same relative distances. The resistance between two TEM equipotentials is maintained the same when the terminator is stretched for sloping.

Note that sloping reduces the electrical stress on the termination resistors for a fixed plate spacing by increasing the length of the resistor chains.

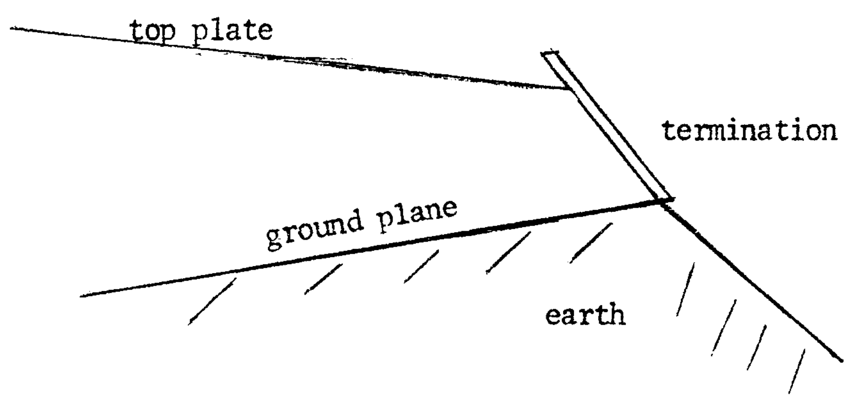
Proper sloping tends to improve the high frequency performance of the termination.

3. Termination geometry for vertical simulator (ATLAS II) - options (side views):

flat ground plane behind termination



sloped ground plane behind termination

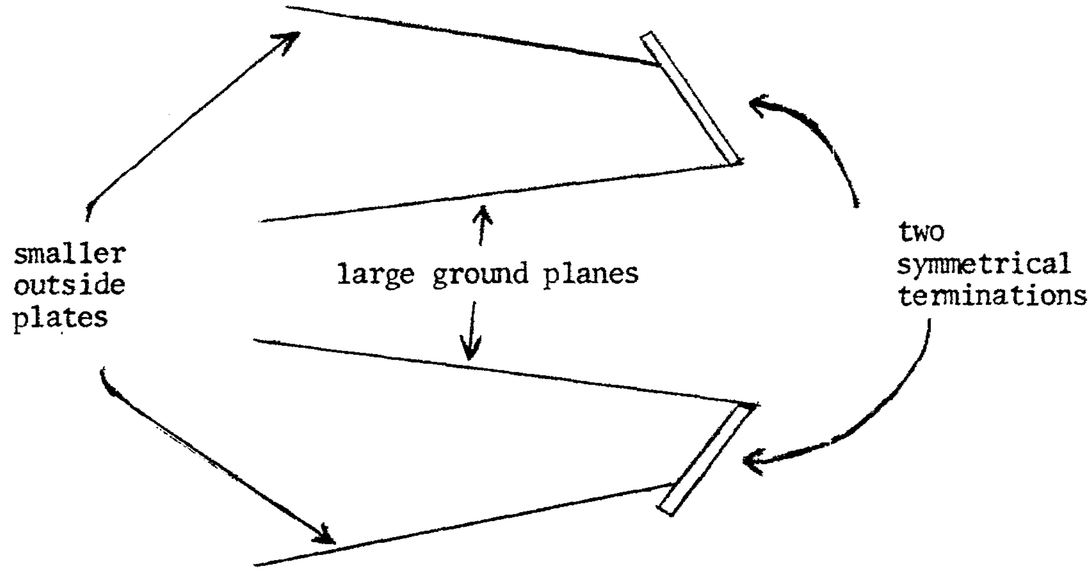


This latter technique effectively raises the impedance for the wave passing through the termination which may be desirable depending on the termination design and how much inductance is needed.

4. Termination geometry for the horizontal simulator (ATLAS I) for case of two transitions to the terminations

- just like 3, except two of them turned on their sides

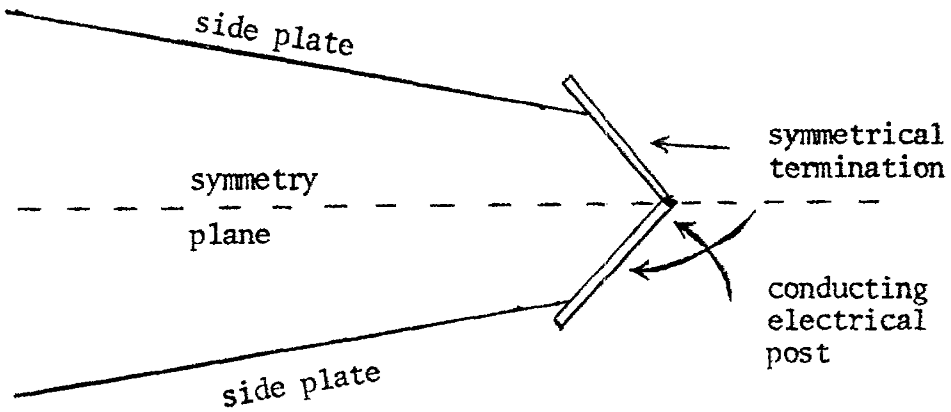
top view



5. Termination geometry for the horizontal simulator (ATLAS I) for case of one transition to the termination

- just like 3 and 4 but based around the vertical symmetry plane

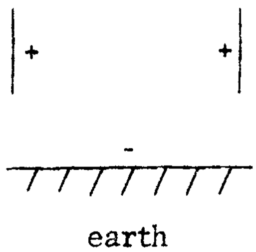
top view



6. Termination of the common mode for the horizontal simulator (ATLAS I) for the case of one transition to the termination

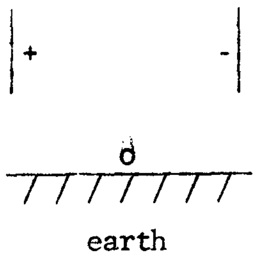
Note that the horizontally polarized transmission line has a common mode of quasi TEM propagation (as discussed for example in SSN 46 with regard to the surface transmission line).

common mode:



This mode is unwanted.

differential mode:



This is the mode the simulator uses.

The common mode will exist because of imperfect balance between the two pulser systems, because of mode conversion associated with lack of perfect symmetry in the simulator (such as earth contouring), and because of mode conversion when an aircraft is not symmetrically placed in the simulator.

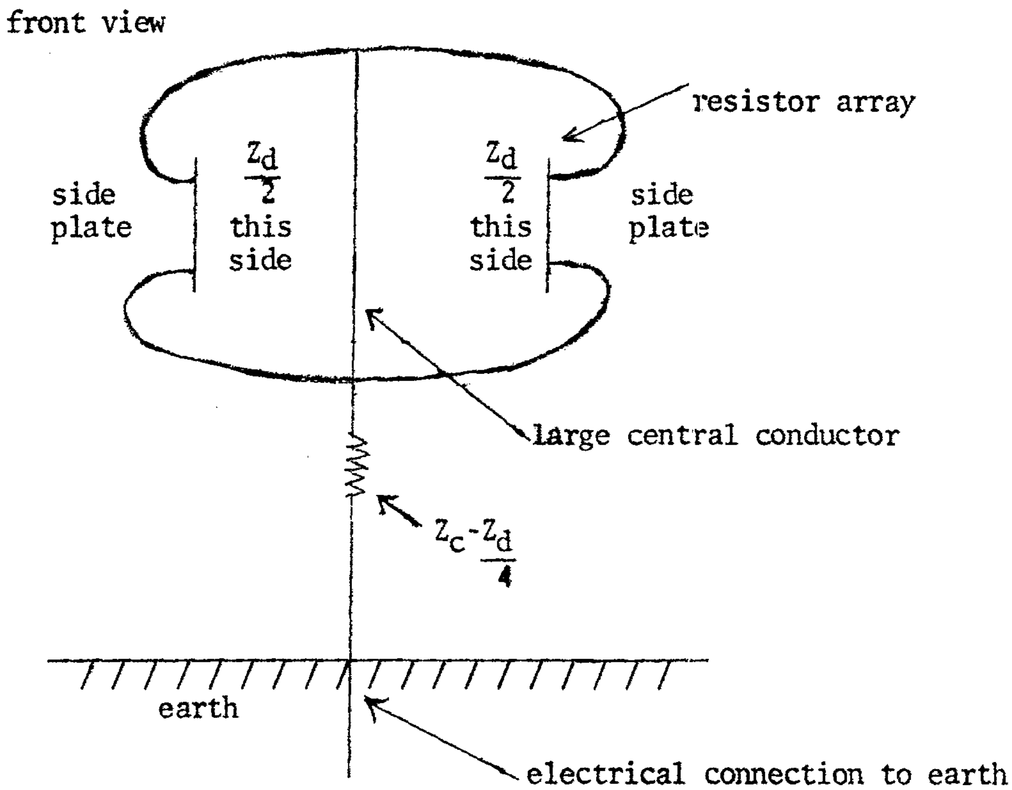
The common mode could rattle back and forth in the simulator since the pulsers have primarily a capacitive impedance. The parallel resistance associated with the charging resistors is of course fairly large.

Thus it would be best if the termination for the common mode were neither an open circuit or short circuit. If one estimates the common mode impedance (it will be approximately resistive a la SSN 46 and a little frequency dependent) then one can terminate the common mode with a resistance that approximates this. Thus the common mode will be roughly terminated on its first pass.

Z_c = common mode impedance

Z_d = differential mode impedance

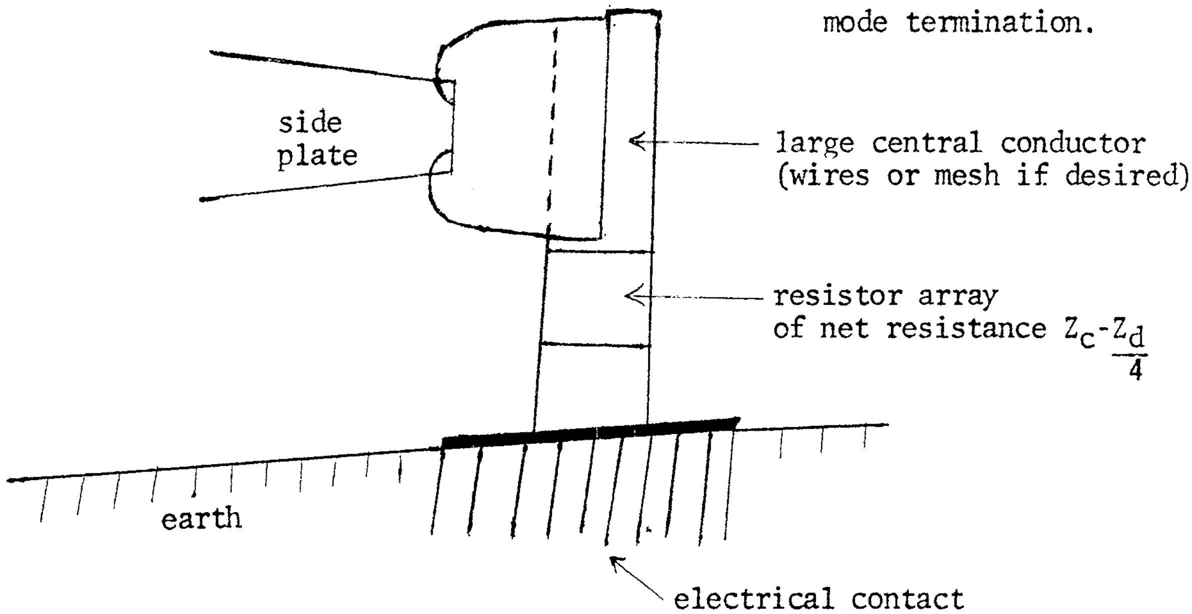
Consistent with the higher quality differential terminator discussed in 5, we can add a portion of the common mode terminator on the symmetry plane of the simulator. Note this is for the case of a single transition to the termination. The case of two output transitions already has the common mode roughly terminated through the connection of the large center ground planes to earth.



Note that the two halves of the differential mode termination combine in parallel to contribute part of the common mode termination. Then added resistance totaling $Z_c - Z_d/4$ is added from the central conductor of the differential terminator to a good electrical contact to earth.

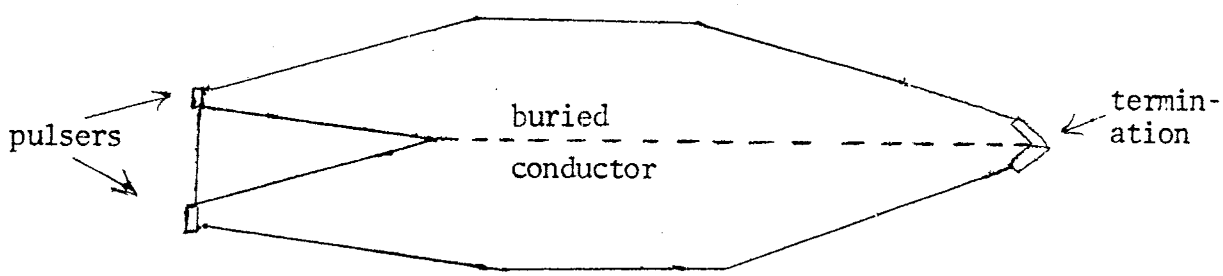
side view

The large width of the connection to earth is simply to lower the inductance in the common mode termination.



Note that if desired, a buried conductor (which might also be a conduit) can run from end to end of the simulator to connect the common mode termination to the earth back to the central ground planes which form parts of the input transitions.

Top view of entire simulator except for the trestle



Note that the buried conductor lies on the symmetry plane of the simulator and to first order does not interfere with the differential mode.