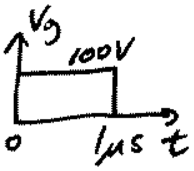
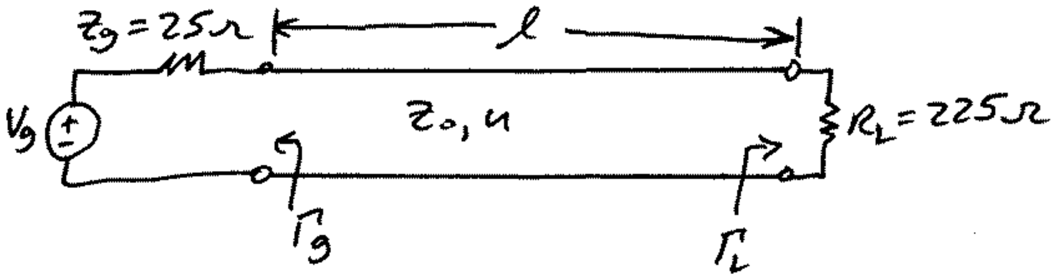




$$Z_o = 75\Omega, \quad u = 1.5\times10^8 \, m/s, \quad \ell = 600m$$

$$\Gamma_L = \frac{R_L - Z_o}{R_L + Z_o} = \frac{225-75}{225+75} = \underline{0.5}$$

$$\Gamma_g = \frac{Z_g - Z_o}{Z_g + Z_o} = \frac{25-75}{25+75} = \underline{-0.5}$$

$$T = \ell/u = \frac{600m}{1.5\times10^8 \, m/s} = \underline{4\,\mu s}$$

spatial length of pulse $= (1\mu s)(1.5\times10^8 \, m/s) = \underline{150\,m}$

a) At $t = 0^+$, the generator turns on and "sees" the generator and transmission line impedances.

Equiv. CKt. $(t = 0^+)$

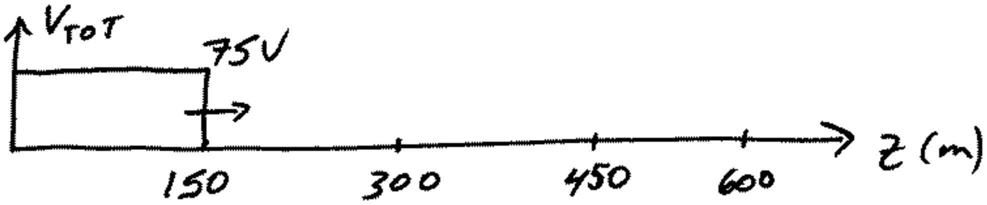
Still has same shape & PW as $V_g(t)$

$$V_{init} = V_1^+ = V_g \frac{Z_{in}}{Z_g + Z_{in}} = 100\left(\frac{75}{25+75}\right) = \underline{75V}$$

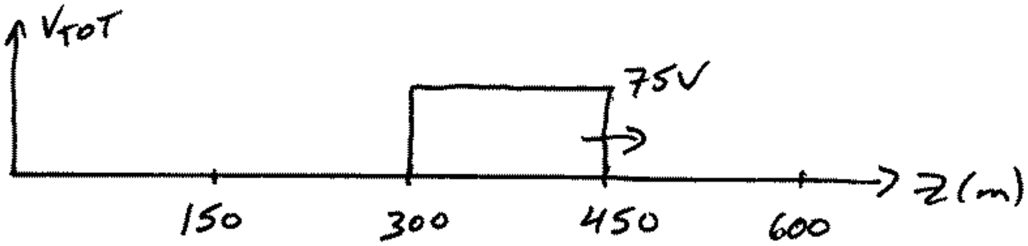
$$I_{init} = I_1^+ = \frac{V_g}{Z_g + Z_{in}} = \frac{100V}{(25+75)\Omega} = \underline{1A}$$

Now, we'll follow the pulse (voltage only) as it propagates on the transmission line.

b) At $t = 1\mu s$, leading edge at $z = 1\mu s\,(1.5\times10^8) = 150\,m$



c) At $t = 3\mu s$, leading edge at $z = 3\mu s\,(1.5\times10^8) = 450\,m$



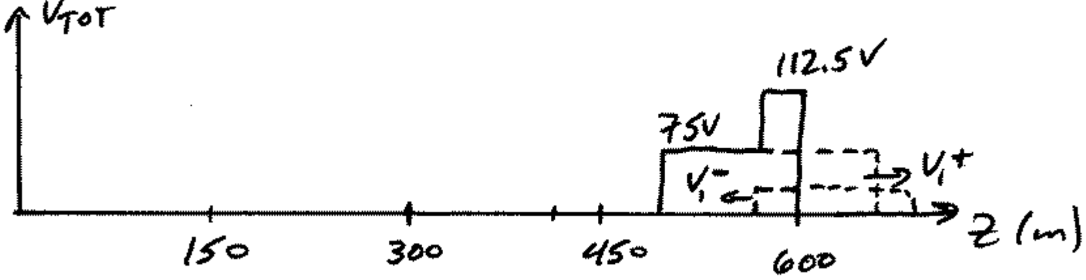
d) At $t = 4\mu s^+ = T$, the leading edge of the pulse arrives at the load and is partially absorbed/ reflected

$$V_1^- = V_1^+\,\Gamma_L = 75(0.5) = \underline{37.5\,V}$$ ← still same shape & duration

e) At $t = 4.25\mu s$, V_1^+ and V_1^- are partially overlaped

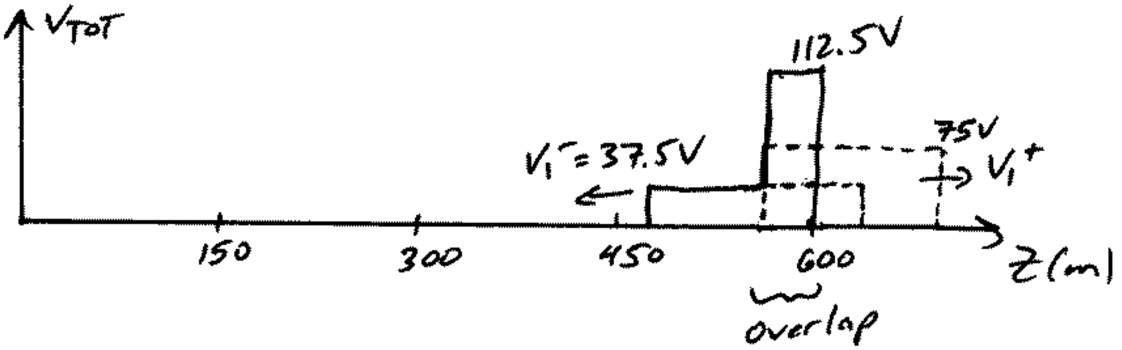
overlap: $V_{TOT} = V_1^+ + V_1^- = 75 + 37.5 = 112.5\,V$

leading edge $4.25\mu s\,(1.5\times10^8) = 637.5\,m$ → 37.5 m back down line



f) At $t = 4.75\mu s$, V_1^+ and V_1^- are still partially overlaped. Leading edge is at

$4.75\mu s\,(1.5 \times 10^8 \, m/s) = 712.5\,m \rightarrow 112.5\,m$ back down the line from the load

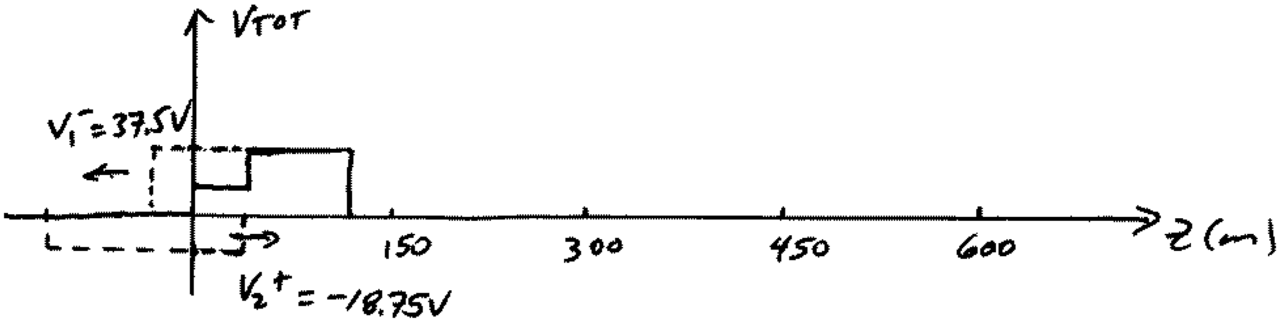


g) At $t = 8\mu s^+ = 2T^+$, the pulse initially reflected from the load (V_1^-) has its leading edge arrives at the generator and is partially reflected

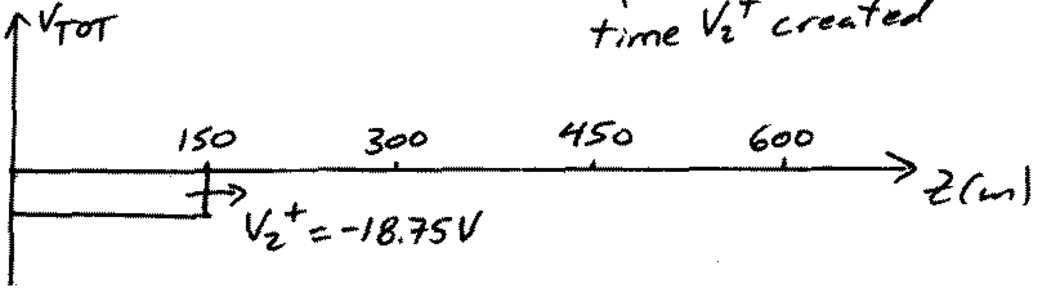
$$V_2^+ = V_1^- \Gamma_g = 37.5(-0.5) = \underline{-18.75\,V}$$

h) At $t = 8.25\mu s$, the pulses V_1^- and V_2^+ are partially overlapped

$$V_{TOT} = V_1^- + V_2^+ = 37.5 + (-18.75) = \underline{18.75\,V}$$



i) At $t = 9\mu s$, only the pulse reflected from the generator (V_2^+) remains, its leading edge is at $(9\mu s - \underset{\substack{\uparrow \\ \text{time } V_2^+ \text{ created}}}{8\mu s})(1.5\times10^8) = 150m$



→ Repeat steps c) – h)

Note: * So far, the voltage has been plotted as a function of position (i.e., versus z) at selected snapshots in time.

* However, the reality is that an oscilloscope measures total voltage as a function of time (i.e., versus t) at a fixed location.

For example, if I had an oscilloscope attached at the load ($z = l = 600m$), I would see: