

The speed of a signal on the PCB trace is given by the following relation.

$$v = \frac{12 \text{ inches}}{\sqrt{\epsilon_r} \text{ nsecs}}$$

The dielectric constant it is roughly 4 for FR4. This means that the speed of light in FR4 is about 6 inches per nsec.

On the other hand, the impedance of the line depends on the capacitance per length C_L , and speed of the signal in material as given below. Here in the following relation I am wondering which speed of signal they use ? There should be 12 instead of 83. Any explanation on this ?

$$Z = \frac{V}{I} = \frac{V}{C_L v V} = \frac{1}{C_L v} = \frac{83}{C_L} \sqrt{\epsilon_r}$$