

Electro-optical delay line

$T_R \approx 10^5 \text{ K} \gg T_0$
F can not be used

Laser diode

Optical fiber

Photo diode

$l \approx 50 \text{ km} \rightarrow t \approx 250 \mu \text{ s}$
 $f \approx 10 \text{ GHz} \rightarrow Q_O = \pi f t \approx 7.9 \cdot 10^6$

$P_0 < 1 \text{ mW}$

Electrical amplifier

Mode-select bandpass filter
 $Q_M \approx 10\% Q_O$

Electrical amplifier

Advantage:
Very high
 $Q_L \approx Q_O + Q_M$

Disdvantages:
Very high T_R
Low P_0
Difficult Q_M

Simplified Leeson
$$L(\Delta f) \approx \frac{1}{8} \cdot \left(\frac{f_0}{Q_L \Delta f} \right)^2 \cdot \frac{k_B (T_G + T_R)}{P_0}$$

Electrical output
 10GHz

