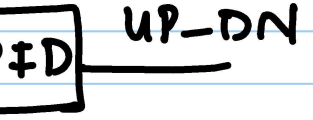
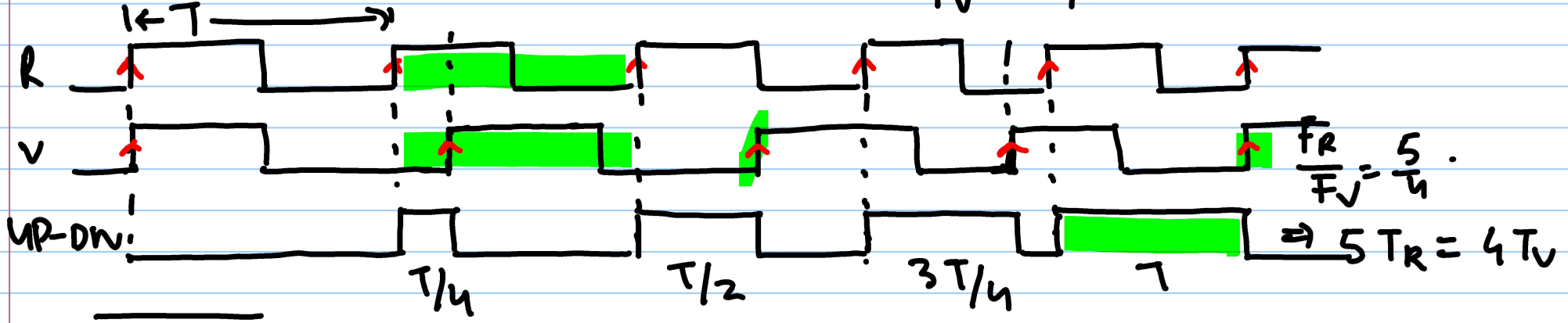
Lecture # 16

Note Title 28-08-2017

PFD as frequency detector:

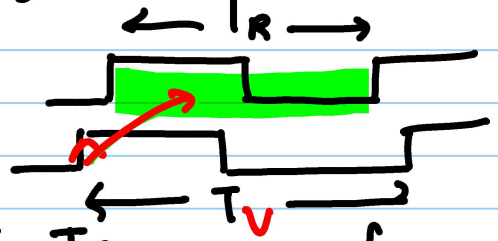
$\frac{F_R}{F_V} = \frac{5}{4}$





$$UP-DN = \frac{1}{5T}\left(\frac{T}{4} + T/2 + 3T/4 + T\right) = 0.5$$

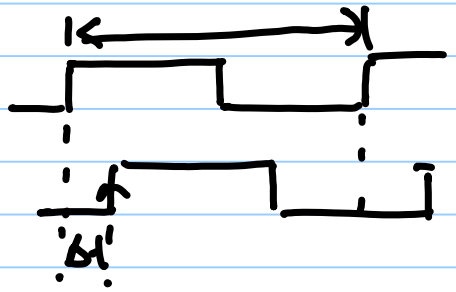
$F_R > F_V \Rightarrow T_R < T_V$



P(V↑transition during one T_R period) $= \frac{T_R}{T_V} = \alpha = \frac{f_V}{f_R}$

P(no V↑ transition happen during 1 T_R period) $= 1-\alpha$

$\overline{UP-DN} = 1$



$UP-DN = \frac{\Delta t}{T_R}$

$\overline{UP-DN}$ when V transition happens during 1 T_R period

$= 0.5$

$\int_0^{T_R} \frac{1}{T_R} \cdot \left(\frac{\Delta t}{T_R}\right) \cdot d(\Delta t)$

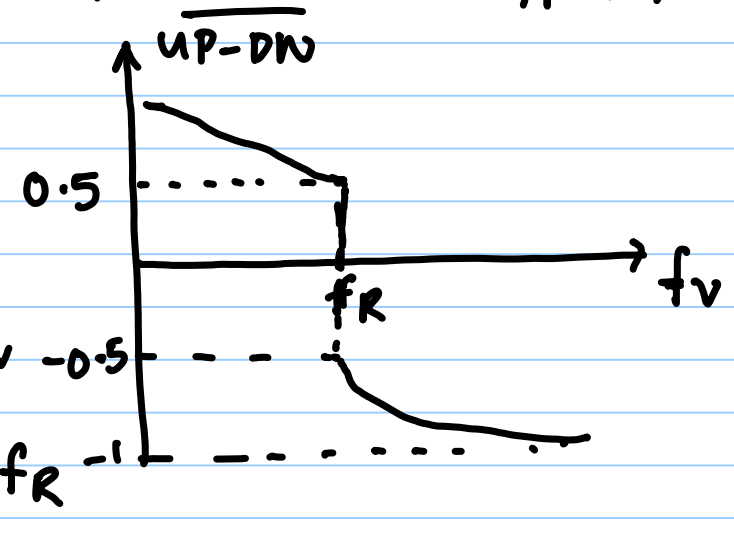
$\overline{UP-DN} = P(V\uparrow \text{ happens}) \times 0.5 + P(V\uparrow \text{ doesn't happen}) \times 1$

$= 0.5\alpha + (1-\alpha) \times 1$

$= 1 - 0.5\alpha$

$\overline{UP-DN} = 1 - 0.5\frac{f_v}{f_R} \; ; \; f_R > f_v$

$\overline{UP-DN} = 0.5\frac{f_R}{f_v} - 1 \; ; \; f_v > f_R$

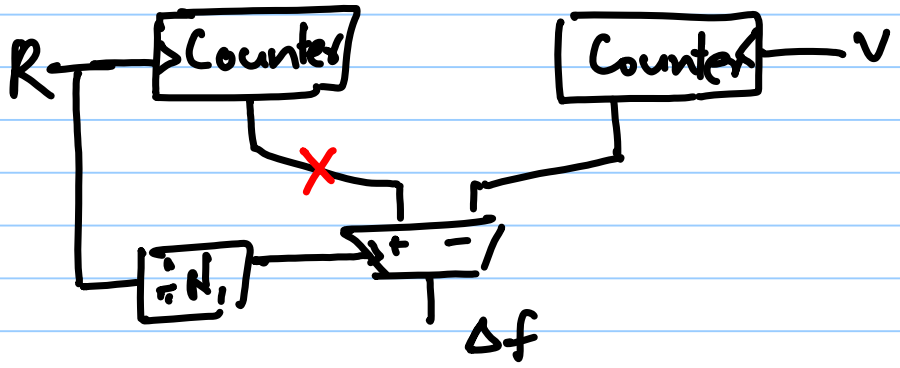


Frequency Detector

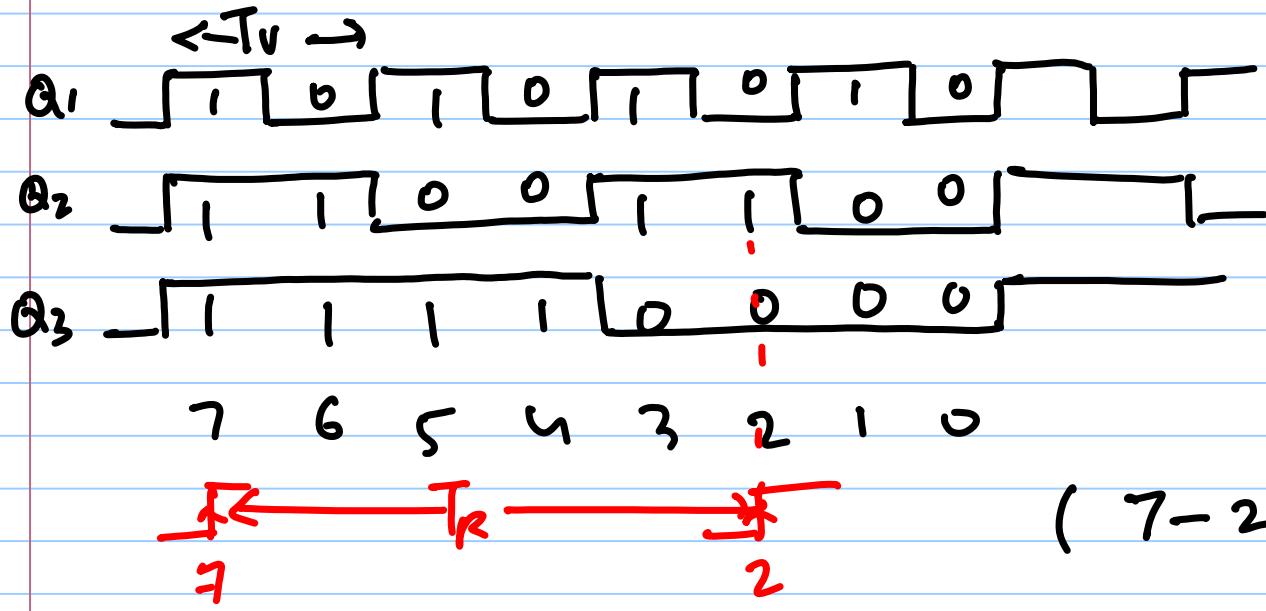
$\frac{F_R}{F_V} = \frac{5}{4} \Rightarrow 5T_R = 4T_V \Rightarrow$ 5 ref. time period = 4 o/p time period.

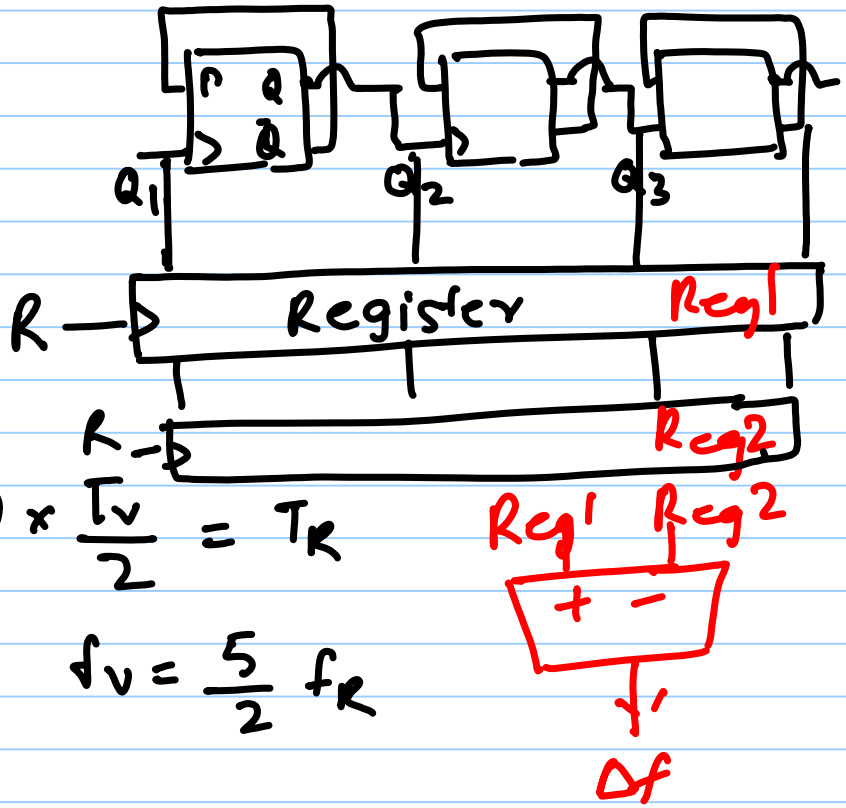
R as reference / known clock.

$N \times T_R = M T_V \Rightarrow f_V = \frac{M}{N} f_R$



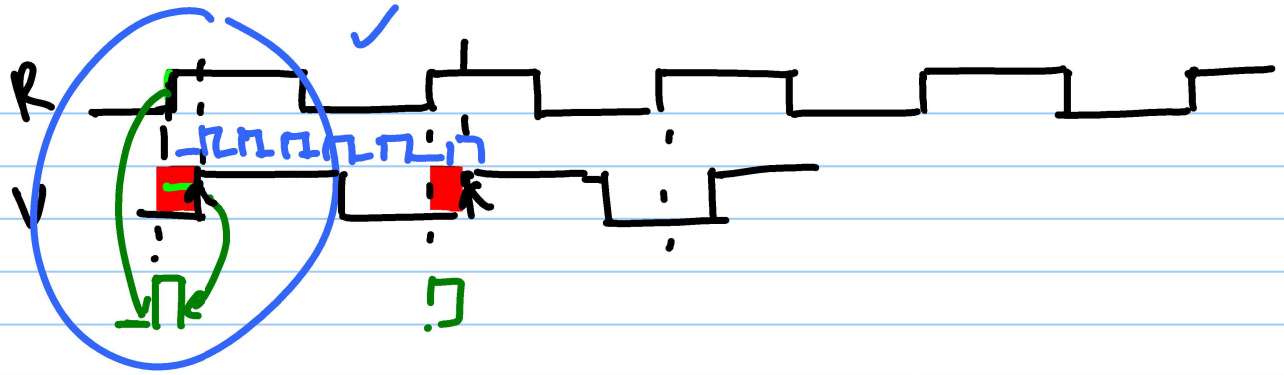
Divider based freq. error detector





$$(7-2)\times\frac{T_v}{2}=T_R$$

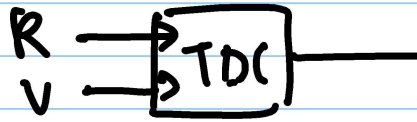
$$\Rightarrow f_v=\frac{5}{2}f_R$$



$$\frac{f_R}{f_V} = \frac{1023}{2041}$$

$$2041\, T_V = 1023\, T_R.$$

Time-to-Digital Converter (TDC)

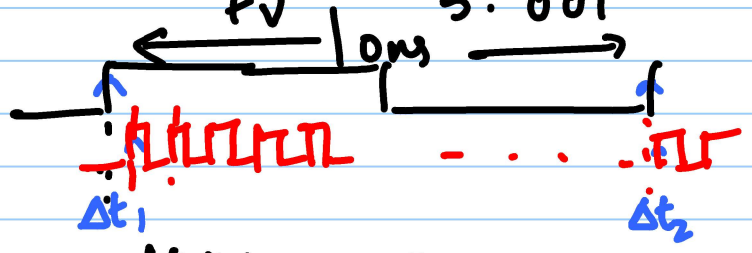


Digital o/p + Counter

Ex: Ref: 100 MHz. 5.0016 GHz.

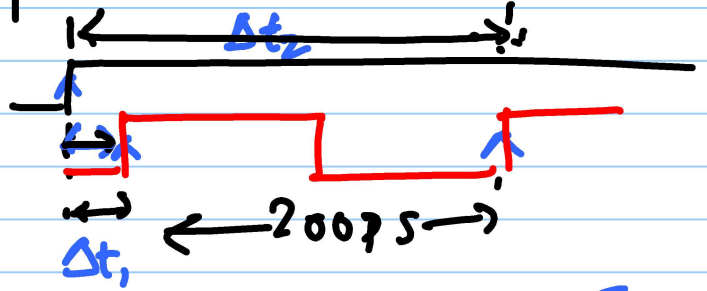
$$T = \frac{1}{5.0016\ \text{GHz}} = 199.96\ \text{ps}.$$

$$\frac{F_R}{F_V} = \frac{0.1}{5.001} = \frac{100}{5001}$$



$$\frac{10\text{ns}}{0.2\text{ns}} = 50$$

$\Delta t_1, \Delta t_2 < T_V$



$\Rightarrow$ TDC Range : $2 \times T_V$

$$50 \times T_v + \Delta t_1 + \Delta t_2 = T_R$$