Lecture # 14

Note Title 18-06-2020

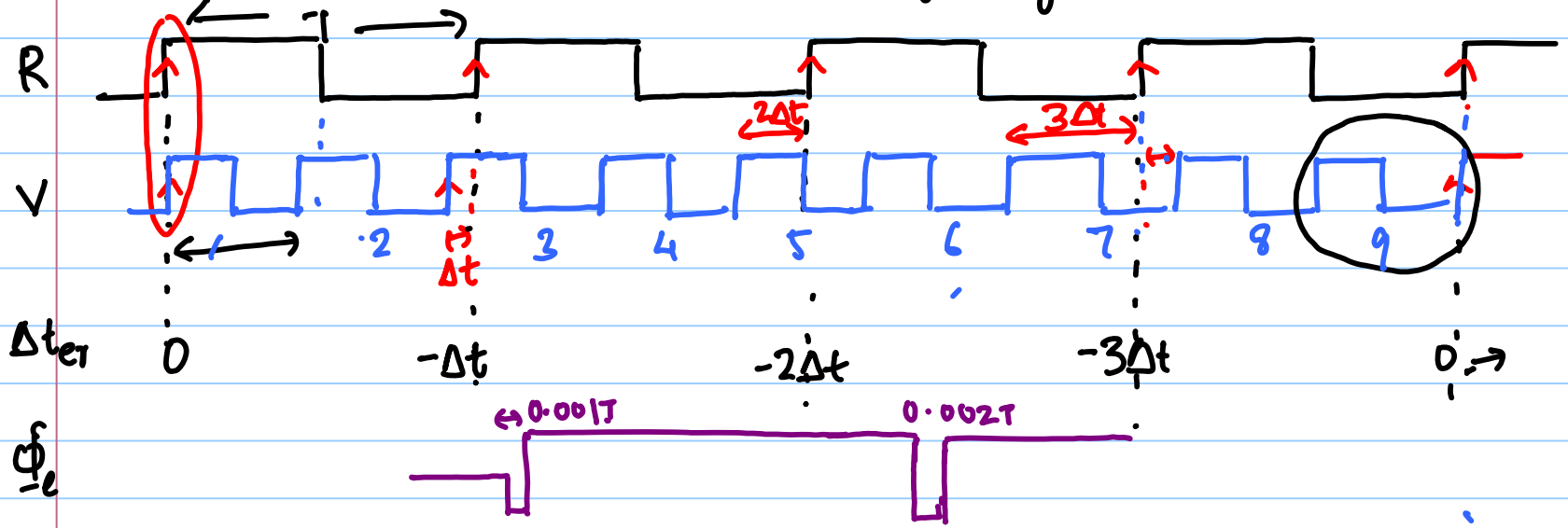
Phase Error Detector.

Analog PD
- Mixer / multiplier based PD
- Sample & hold based PD ✓

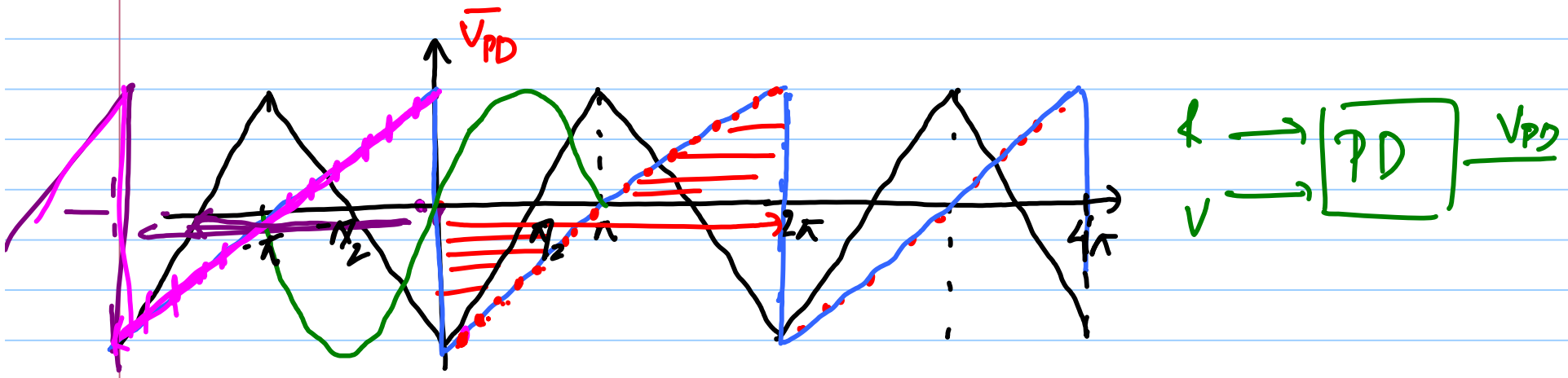
Digital PD
- XOR - based PD
- SR flip flop based 2-state PD
- 3-state PFD
- D-flip flop based PD

- linear / montonous range of Dp.
- Gain of PD, $K_{PD} = \frac{d(\bar{V}_{PD})}{d\hat{\Phi}_E}$

Whether we can use PDs as frequency detectors?

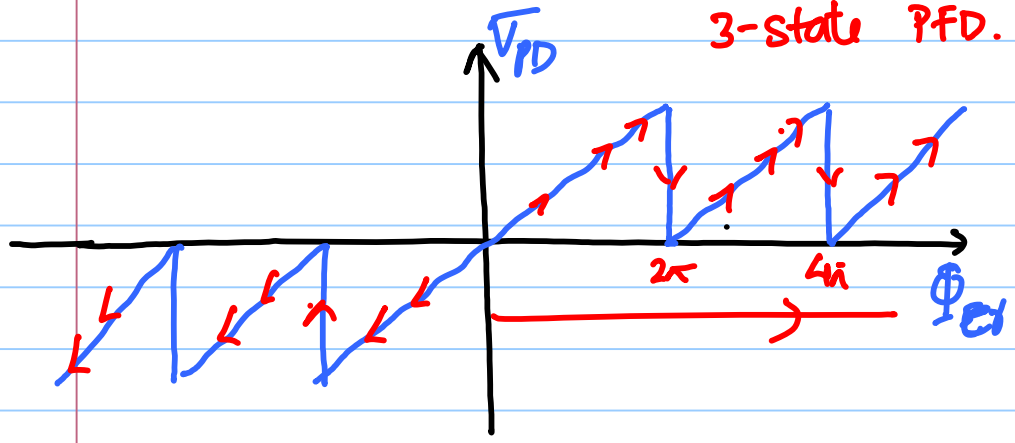


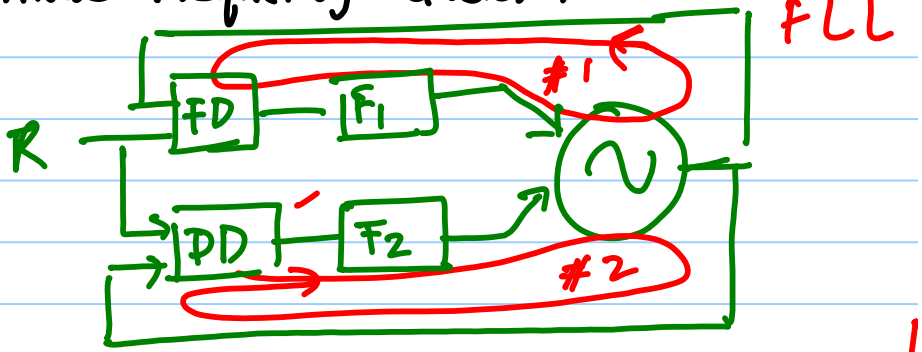
$$\frac{f_V}{f_R} = 2.25 \Rightarrow \frac{T_R}{T_V} = 2.25 \Rightarrow \frac{T_R}{T_V} = \frac{225}{100} \; 9 \; 4$$



- Phase error accumulates and edge realign after accumulating IT.

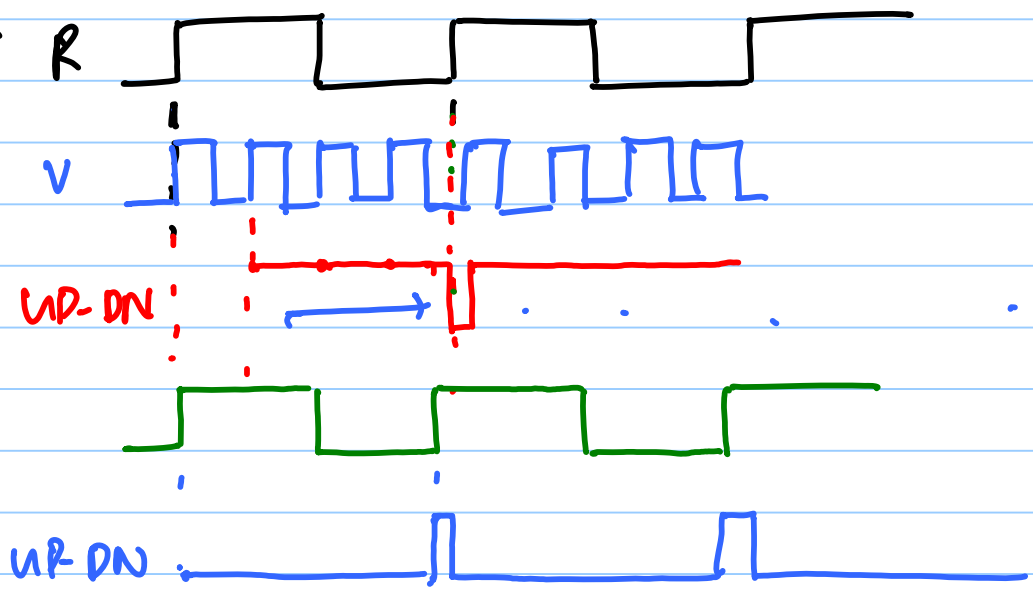
3-state PFD. (Phase Frequency Detector)





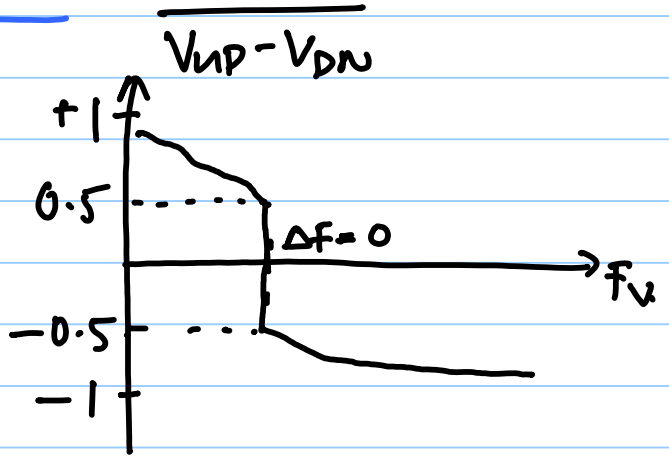
Frequency Transfer Characteristics.

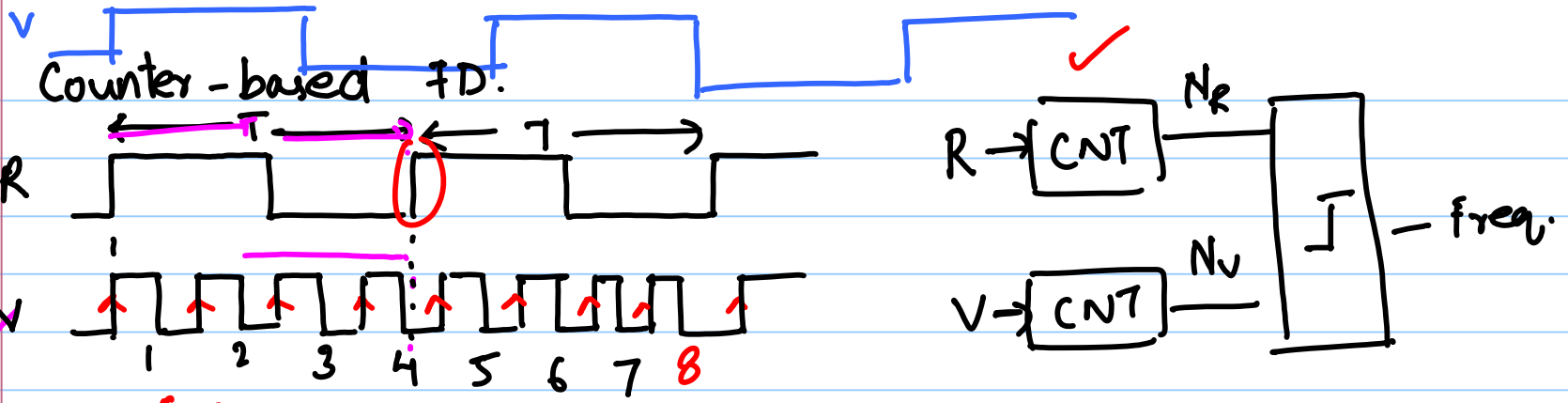
$F_V > F_R$



$\overline{V_{UP} - V_{DN}}$

$$\overline{V_{UP} - V_{DN}} = \begin{cases} 1 - \dfrac{0.5 F_V}{F_R}, & \text{if } F_V < F_R \\ \dfrac{0.5 F_R}{F_V} - 1, & \text{if } F_V > F_R \end{cases}$$





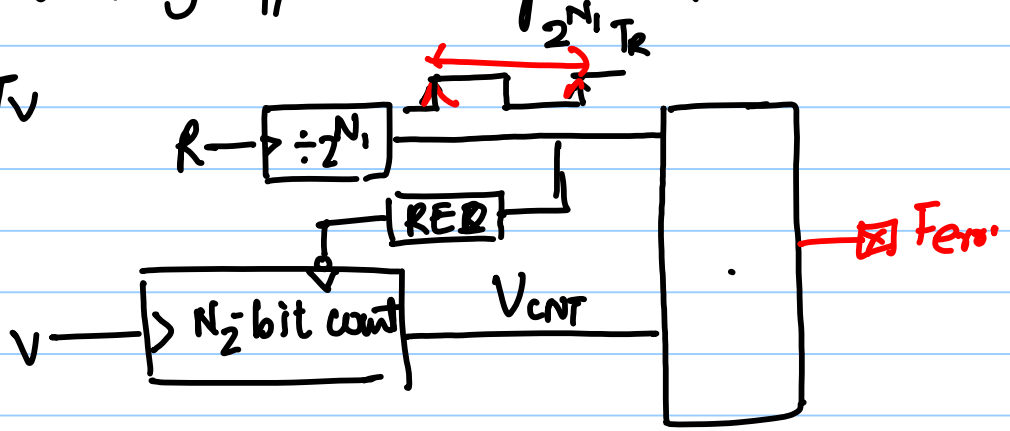
$T = 4T_V$

$2T = 8T_V$

- Larger reference period $\Longrightarrow$ o/p freq. more accurately.
- Increase the time for counting o/p clock periods.

$$T_R = 4.25T_V = \frac{17}{4}T_V$$

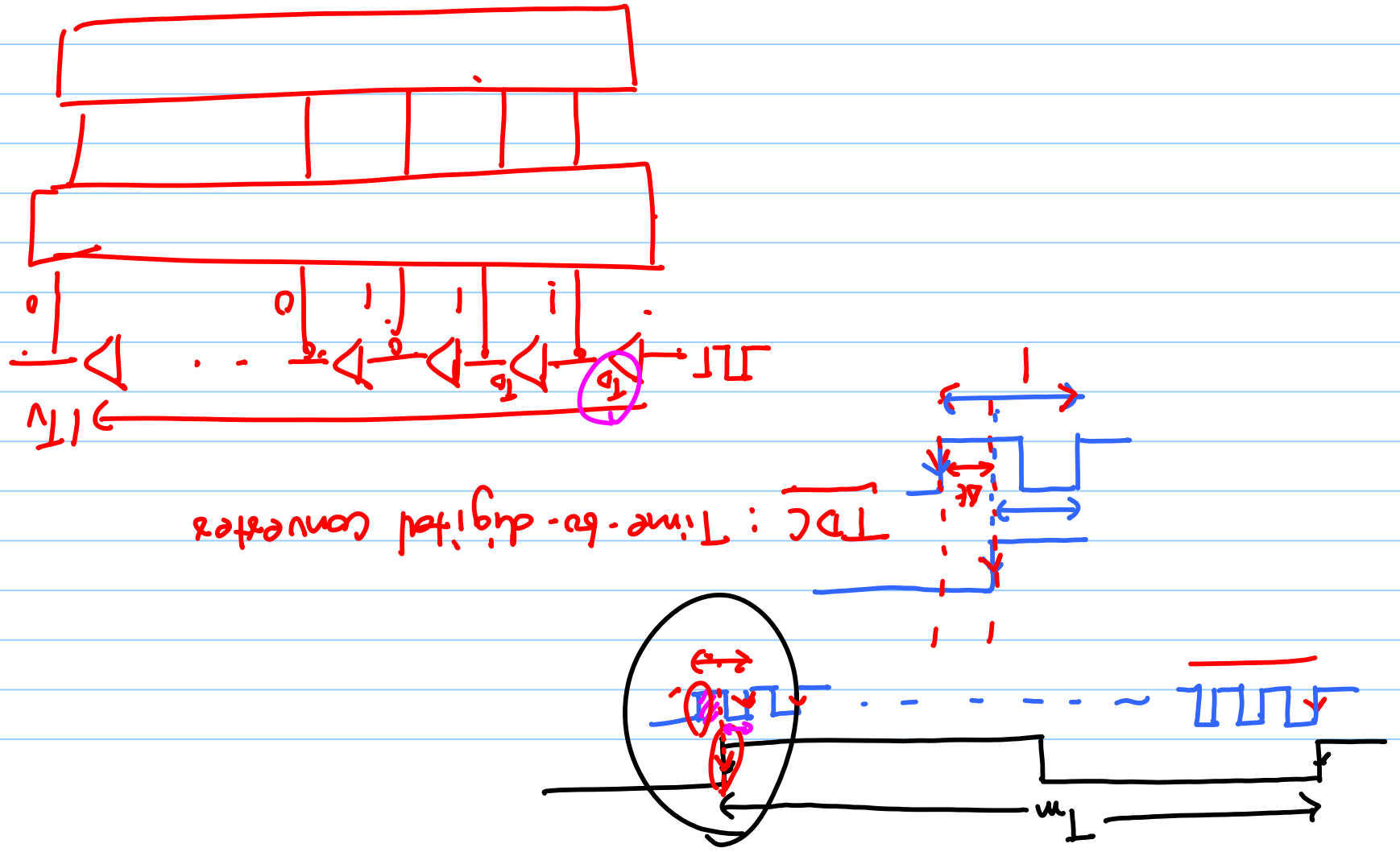
$$4T_R = 17T_V$$



$$Fer = \frac{\Delta F}{F_R} \times 10^6 \ (ppm)$$

V_{CNT1}

V_{CNT2}


TDC : Time-to-digital converter