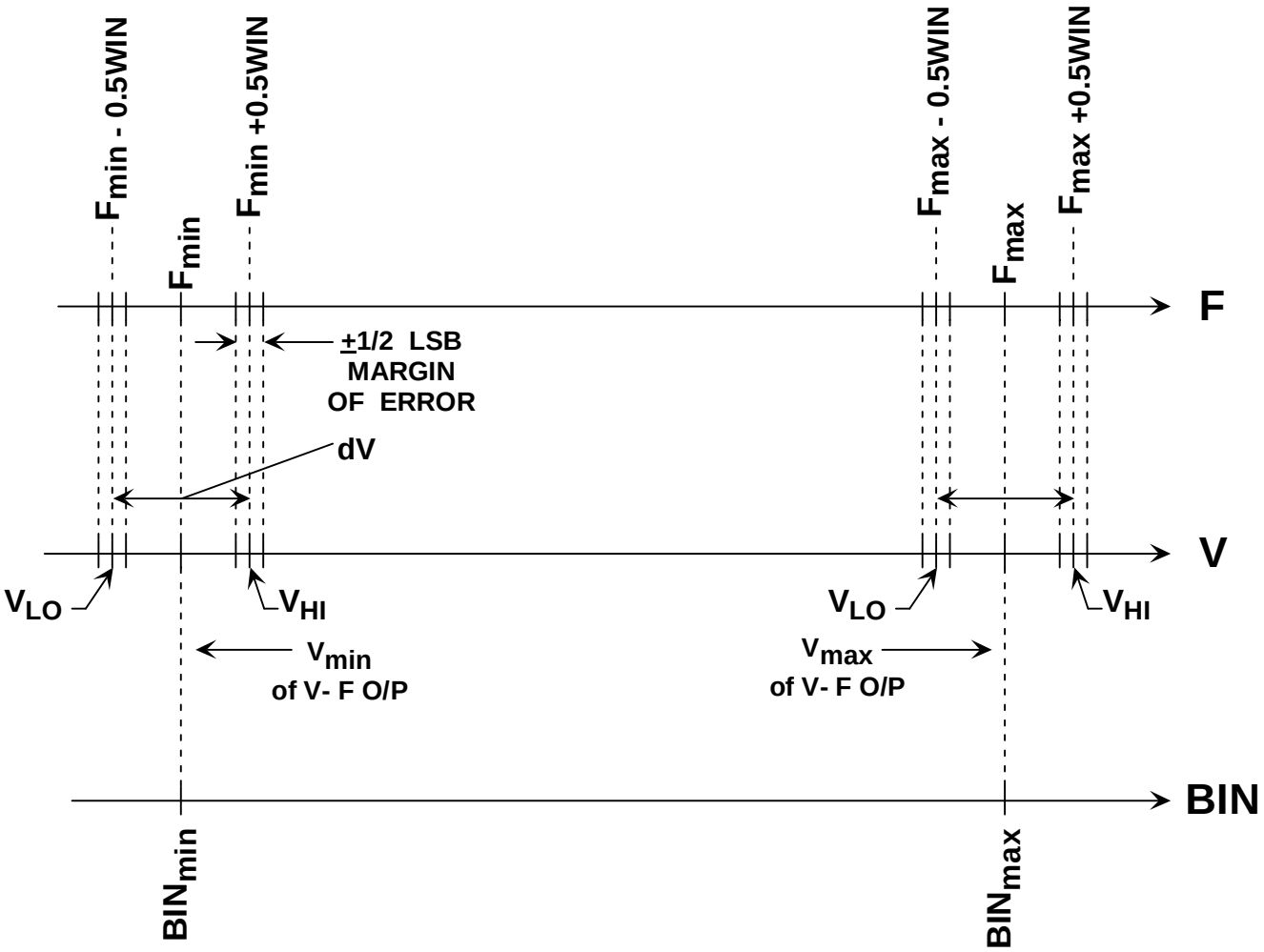
PROGRAMMABLE FREQUENCY WINDOW DETECTOR
PRE-LAB PROCEDURE




1. Translate all frequencies to equivalent voltages using the $V_{max}$ and $F_{max}$ specs.

2. Find the binary range knowing that ΔF corresponds to 1 LSB of the DAC
   Note that the binary range is not 0 to 255

3. Design the DAC for $V_{cen}$ ranging from $V_{min}$ to $V_{max}$

4. Design A2 stage for two desired desired dV values corresponding to the two frequency windows.

5. Design the input Schmitt trigger – center trigger point about 0V

6. Design the window detector with a hysteresis value small enough to obtain the desired accuracy on the frequency window - accuracy needed is ± ½ LSB , therefore use a maximum hysteresis value of ½ LSB but no less than 15mV. Do not use hysteresis too low as you may experience chattering at O/P if there is too much noise.

7. Design the V to F converter for $V_{min}$ to $V_{max}$ range and a maximum O/P ripple voltage that is ¼ of the hysteresis of the window detector.

$$V_{out\,(ave)} = I_{SW\,(ave)} \times R_L = I_S \left(\frac{PW}{T_{in}}\right) \times R_L = (I_S R_L) \times F_{in} \times PW = V_{\min} \text{ to } V_{\max}$$

where $I_S = I_{REF}$ of the LM331 and PW is current pulses'PW determined by the on board timer whose $R_T C_T$ determines the PW.

For $F > 10/(2\pi R_L C_L)$ , the F→V output ripple voltage is given by

$$\Delta V_{out\,(pp)} = \frac{I_S R_L}{8} \times \left(\frac{PW}{R_L C_L}\right)^2 \times \left(\frac{1}{F \times PW} - 1\right)$$

A) Assume PW = 0.5 $T_{min}$ to be safe and calculate $R_T$ and $C_T$ required – recalculate exact PW with standard $R_T$ and $C_T$ values.

B) Using $V_{out\,(ave)} = (I_S R_L) \times F_{in} \times PW = V_{\min} \text{ to } V_{\max}$
solve for $(I_s R_L)$ and then solve for $R_L C_L$ from

$$\Delta V_{out}\ \max = \frac{I_S R_L}{8} \times \left(\frac{PW}{R_L C_L}\right)^2 \times \left(\frac{1}{F_{\min} \times PW} - 1\right) \approx \frac{I_S R_L}{8} \times \left(\frac{PW}{R_L C_L}\right)^2 \times \left(\frac{1}{F_{\min} \times PW}\right)$$

$$\Delta V_{out}\ \max = \frac{(I_S R_L)\, PW}{8\, F_{\min}} \times \frac{1}{(R_L C_L)^2} \quad \Rightarrow \quad R_L C_L = ?$$

Select standard $C_L$ and $R_L$ and then calculate $I_S$ required to provide the $V_{min}$ to $V_{max}$ range and then find $R_{ref}$ needed for the $I_s$ value you calculated. Select components in order to get an $I_S$ value that lies between 0.1 mA and 1.5 mA

C) DC bias the inputs of the LM331 properly, "in" and "threshold" pins 6 and 7, and then calculate an appropriate AC coupling capacitor for an appropriate input time constant – see notes for details.

D) Determine risetime of V to F O/P filter

Hand in all pre-lab calculations along with **a neat circuit diagram** showing all standard component values.