OPA2364

Condition:

$C_L = 100pF$, $V_S = +5V$, $V_{STEP} = 4V$, $G = +1$

Settling time:

To 0.1% : 1 μs

To 0.01% : 1.5 μs

15x longer than the time for the RC filter to settle to 0.01%.

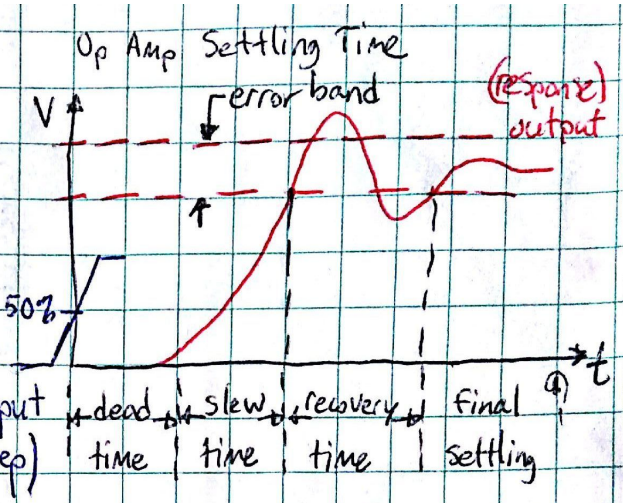
Specify error band: $\frac{1}{4}$ LSB

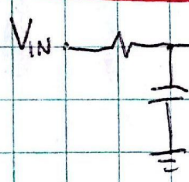
$\frac{2.5V}{2^{16}} = 38\mu V$ error band: $\frac{38\mu V}{4} \approx 10\mu V$

.01% of 2.5V $= 2.5\times10^{-4}V = 250\mu V = 6.5$ LSB

This is good enough. See if there is enough time to take 4 readings per pixel for increased of 1 bit of resolution.

Op Amp Settling Time





$R = 100\Omega$

$C = 100pF$

$\tau = 10ns$

$1.5\mu s = 1500ns$

1.5 μs is 150 τ!

V_{IN} Step at t=0: initial condition, $V_{OUT} = 0V$.

$C = q/V$ $\quad i_C = \frac{dQ}{dt}$ $\quad i_C = i_R = \frac{V_{IN} - V_{OUT}}{R}$

$V_C = \frac{1}{C}Q$

KVL: $V_R + V_C = V_{IN}$, $V_C = V_{OUT}$

$\frac{dV_C}{dt} = \frac{1}{C} i_C$

$(V_{IN} - V_{OUT})\frac{1}{R} = C\frac{dV_{OUT}}{dt}$

$V_{IN} = V_{OUT} + RCV'_{OUT}$

V_{OUT} of form Ae^{st} $\quad V'_{OUT} = sAe^{st}$ $\quad V_{OUT} = Ae^{-t/RC}$

i.c.: $V_{OUT} = 0$ @ $t = 0$ $\quad e^0 = 1$ $\quad V_{OUT} = A(1 - e^{-t/RC})$

f.c.: $V_{OUT} = V_{IN}$

$\lim_{t\to\infty} e^{-t/RC} = 0$

$A = V_{IN}$

$V_{OUT} = V_{IN}(1 - e^{-t/RC})$

Calc $\frac{V_{OUT}}{V_{IN}}$ @ $t = 1.5\mu s$:

$1 - e^{-\alpha}$

$\alpha = \frac{1.5\mu}{100\Omega \cdot 100e{-}12\,F} = t/\tau$

$0 = Ae^{st}(1 + sRC)$

$sRC = -1$

$s = \frac{-1}{RC}$