Expression for transmission error : Assume that linear sweep is applied to the high pass RC circuit .input and output waveforms are shown in figure.

Now $e_t = \frac{V_s^{'} - V_S}{V_S^{'}}$

amplitude of linear sweep is $V_S^{'} = \alpha T_S$

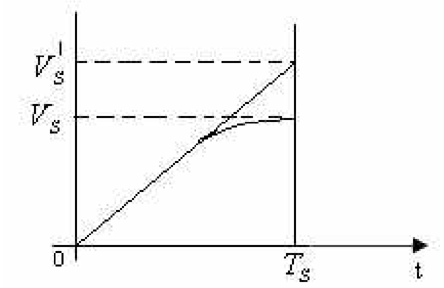
where α is slope of linear sweep waveform(input).

Initially, slope of the output waveform is same as slope of the input waveform.

So now we need to determine slope of the output waveform at t=0.

We know equation for output waveform is ,

$V_0 = V(1 - e^{-\frac{t}{RC}})$



Initial slope of the waveform is $\left(\frac{dV_O}{dt}\right)_{t=0} = \frac{V}{RC}$

Therefore $V_S^{'} = \frac{VT_S}{RC}$ ------(1)

Amplitude of output waveform is $V_S = V(1 - e^{-\frac{T_S}{RC}})$

If $\frac{T_S}{RC} << 1$ we know $e^{\frac{-Ts}{RC}} = \left(1 - \frac{T_s}{RC} + \left(\frac{T_s}{RC}\right)^2 \frac{1}{2!} - ....\right)$

By neglecting higher order terms,

$$e^{\frac{-Ts}{RC}} = \left(1 - \frac{T_s}{RC} + \left(\frac{T_s}{RC}\right)^2 \frac{1}{2!}\right)$$

There fore,

$$V_S = \frac{VT_S}{RC}(1 - \frac{T_S}{2RC}) \text{---------(2)}$$

From equations (1) &(2) ,

$$e_t = \frac{T_S}{2RC}$$

Relation between the errors associated in sweep waveforms are

$$e_d = \frac{e_s}{8} = \frac{e_t}{4}$$

** In the above derivations we are assumed that RC is the time constant of a circuit.

Methods of generating Time –Base waveforms : (Voltage sweeps)

1. Exponential charging circuit
2. Constant current charging circuit
3. Miller sweep circuit
4. Bootstrap sweep circuit.

To produce voltage sweeps basic element is a capacitor.

Exponential charging circuit (Sweep circuit) : .

Basic principle: In an exponential charging circuit , capacitor charges exponentially

towards the supply voltage. Here voltage across the capacitor is ,

$Vo(t) = V(1 - e^{-\frac{t}{RC}})$ consider RC is the time constant of a circuit.

If time provided to charge the capacitor is more, then voltage across the capacitor is a raising exponential.

But if time provided to charge the capacitor is less, Then voltage across the capacitor is a sweep voltage.

Since if t is small $\left(\frac{t}{RC} << 1\right)$, we know $e^{\frac{-t}{RC}} = \left(1 - \frac{t}{RC} + \left(\frac{t}{RC}\right)^2 \frac{1}{2!} - ....\right)$

By neglecting higher order terms, $e^{\frac{-t}{RC}} = \left(1 - \frac{t}{RC}\right)$

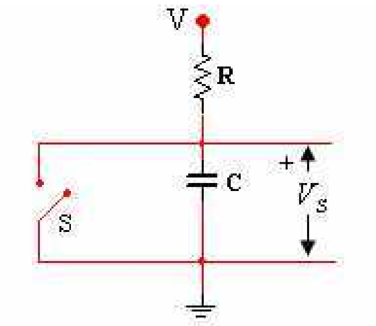
There fore, $Vo(t) = \frac{V}{RC}t = \alpha t$ it is a sweep waveform.

In other words , to produce voltage sweeps from exponential charging circuit , voltage across the capacitor must be small compared to the supply voltage.

Operation : exponential charging circuit is shown in figure below.

Here switch is placed in parallel with a capacitor to produce voltage sweeps.

Initially switch is opened , so capacitor charges exponentially towards V with a Time constant RC . after certain time , switch needs to close then capacitor will Tries to discharge immediately.
(assume switch resistance is zero in closed state)



Waveform is shown below,

Many devices are available to serve as the switch in the above figure. generally we prefer negative resistance devices like UJT.