Need for speed

[AN-NS92]

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- E.g. signals in video applications:

Video format	vertical freq. Hz	pixel period ns	rise time ns	SR V/μs	BW MHz
TV	30	262	87	16	4
640 x 480	60	39	13	107	27
1024 x 768	60	15	5	274	69
1152 x 864	60	12	4	347	87
1152 x 864	85	9	3	492	123
1920 x 1200	70	4	1	938	234
1600 x 1200	85	4	1	949	237
2048 x 1536	60	4	1	1097	274

- Two aspects
  - bandwidth / step response
  - large signals

Bandwidth and step response

- $\omega_{cut} = 2\pi f_{cut} = 1/\tau$ i.e. $f_{cut} = 1/(2\pi\tau)$

- rise time t_r: 10% -> 90%:

  $t_r = \tau \ln(0.9/0.1) \sim 2.2\ \tau$

- settling time to 1%

  $t_s = \tau \ln(100) \sim 4.5\ \tau$

- settling time, e.g. to 0.1% of final value (from 0%, ideally):

  $t_s = \tau \ln(1000) \sim 7\ \tau$

Large signals

Pay attention to the *slew rate* (in V/μs)!

- e.g.: 741 (SR=0.67 V/μs, GBP=1 MHz) as voltage follower
  - $f_{cut}=f_T$=1 MHz -> τ=160 ns
- sinusoidal signal: $x=A\sin\omega t$
  - $x'=A\omega\cos\omega t$ -> $x'_{max}=A\omega$
  - the limit at 1 MHz is for $A\omega$=SR -> A_{max}=107 mV
- *for large A, the behaviour is often limited not by the bandwidth but by the slew rate*

- similarly, with the step response: if $x_{out}=A(1-\exp(-t/\tau))$,
  - $x'_{max}=A/\tau$
  - the limit is for A/τ = SR -> A_{max}=107 mV