

# Signal processing

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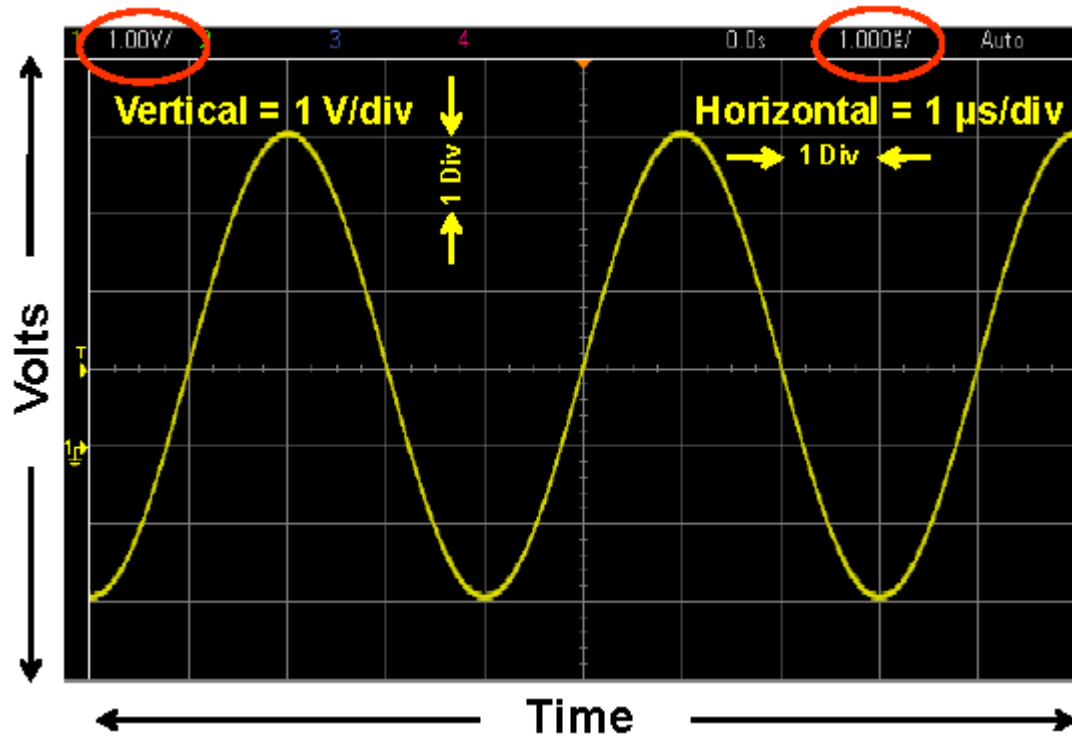
- ❖ Working with an oscilloscope
- ❖ Signal processing



# Digital Oscilloscope

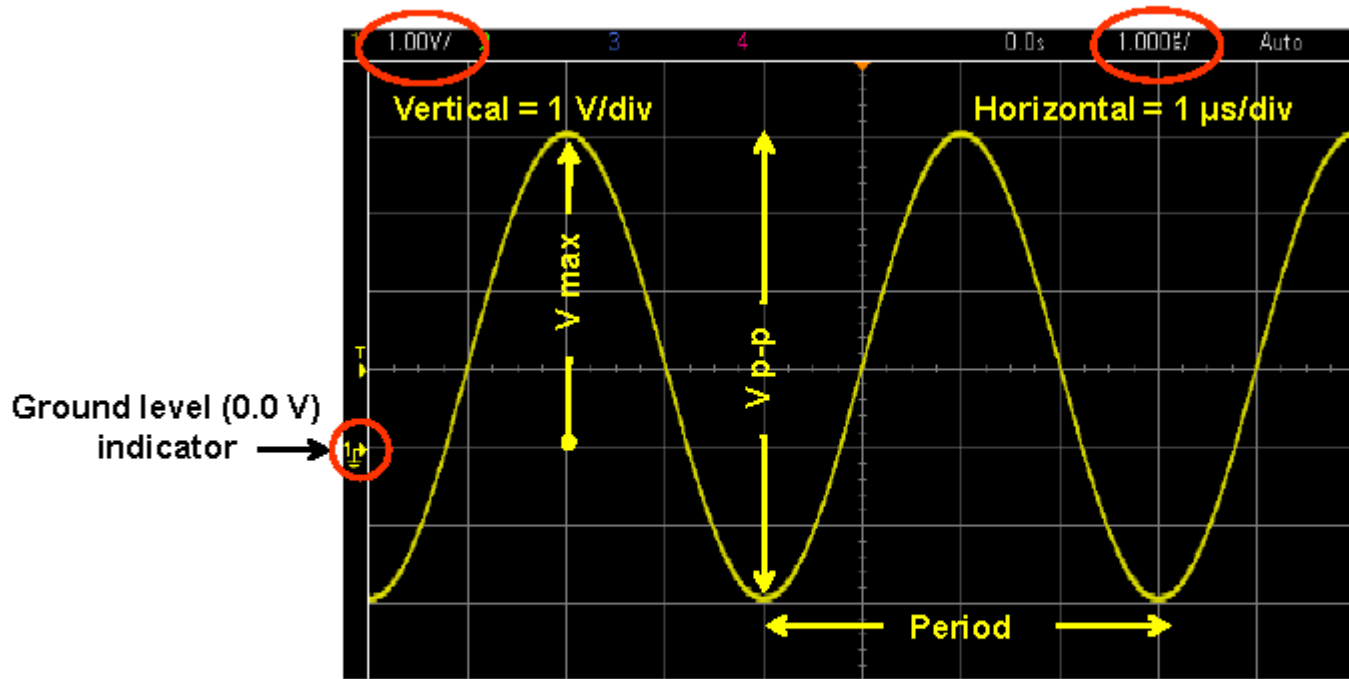


# Understanding the Scope's Display



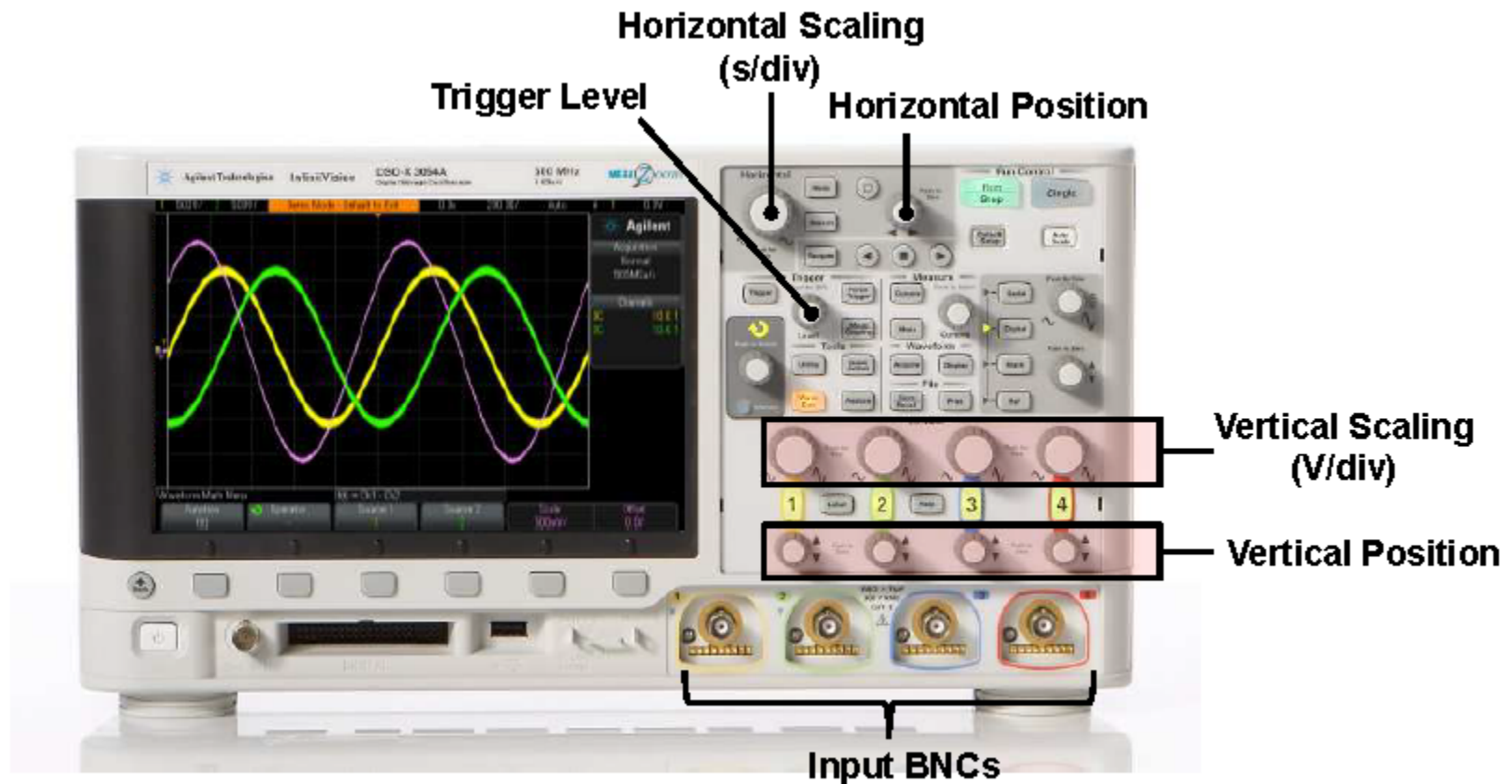
# Making Measurements – by visual estimation

## *The most common measurement technique*



- Period ( $T$ ) = 4 divisions  $\times$  1  $\mu$ s/div = 4  $\mu$ s, Freq =  $1/T$  = 250 kHz.
- $V_{p-p}$  = 6 divisions  $\times$  1 V/div = 6 V p-p
- $V_{max}$  = +4 divisions  $\times$  1 V/div = +4 V,  $V_{min}$  = ?

# Primary Oscilloscope Setup Controls

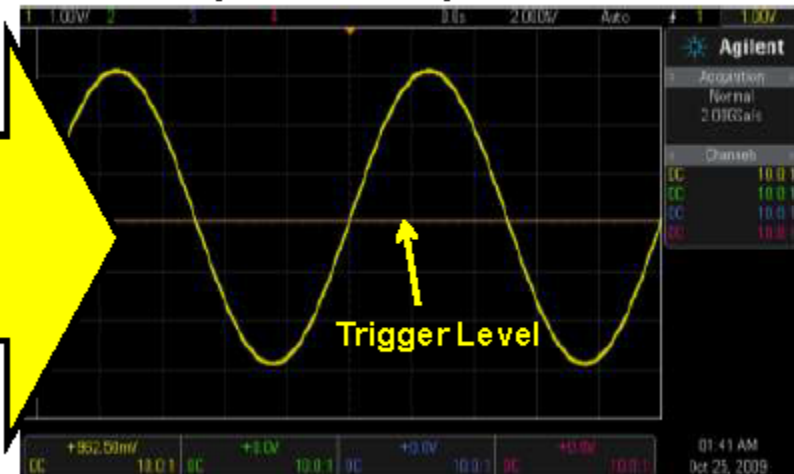


# Properly Scaling the Waveform

Initial Setup Condition (example)



Optimum Setup Condition



# Understanding Oscilloscope Triggering

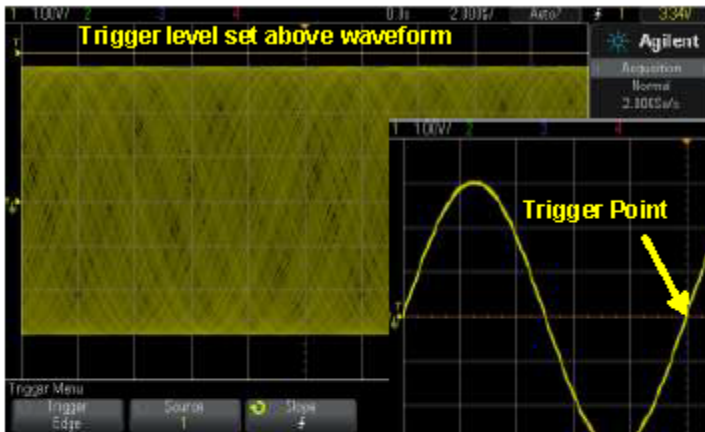
*Triggering is often the least understood function of a scope, but is one of the most important capabilities that you should understand.*

- Think of oscilloscope “triggering” as “synchronized picture taking”.
- One waveform “picture” consists of many consecutive digitized samples.
- “Picture Taking” must be synchronized to a unique point on the waveform that repeats.
- Most common oscilloscope triggering is based on synchronizing acquisitions (picture taking) on a rising or falling edge of a signal at a specific voltage level.

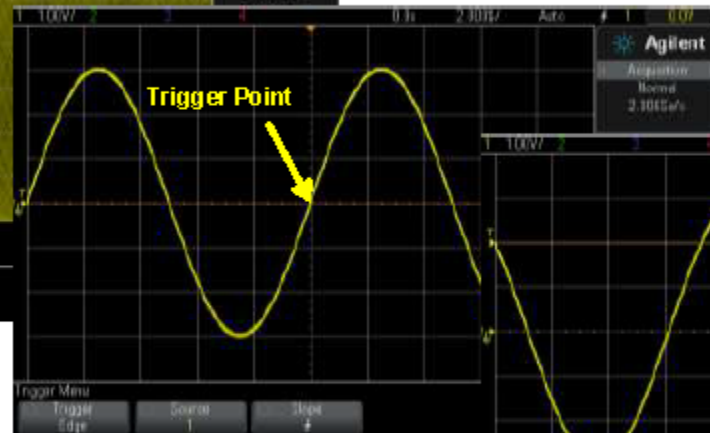


**A photo finish horse race is analogous to oscilloscope triggering**

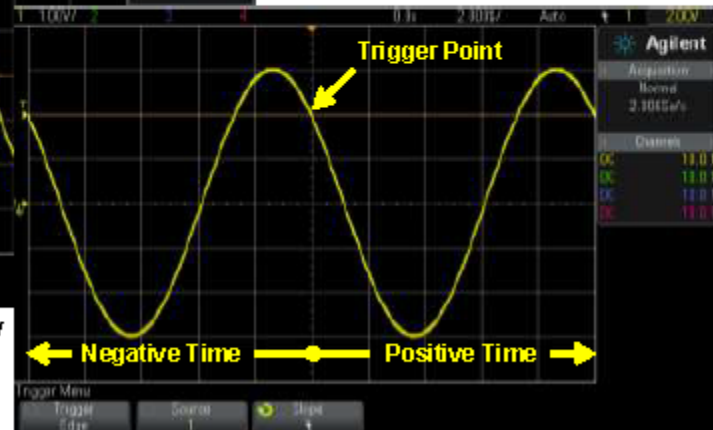
# Trigger Examples



Untriggered  
(unsynchronized picture taking)



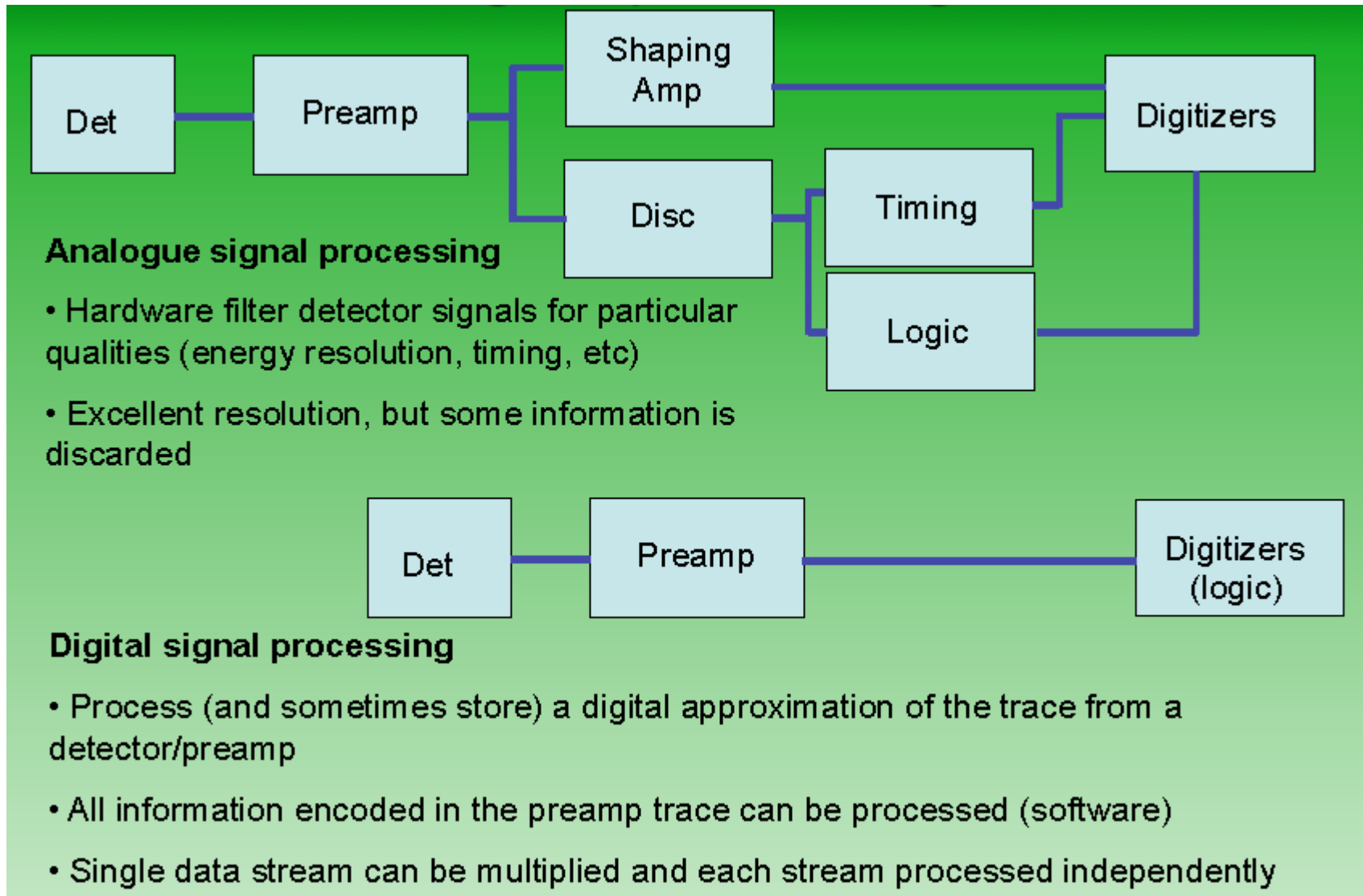
Trigger = Rising edge @ 0.0 V



Trigger = Falling edge @ +2.0 V



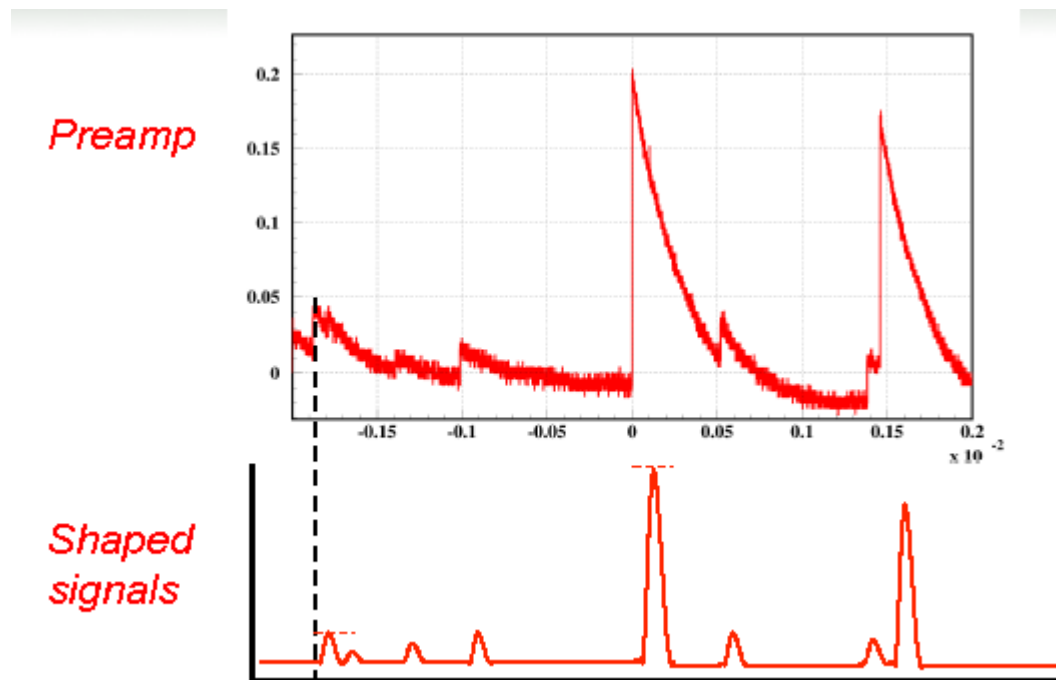
# Signal processing



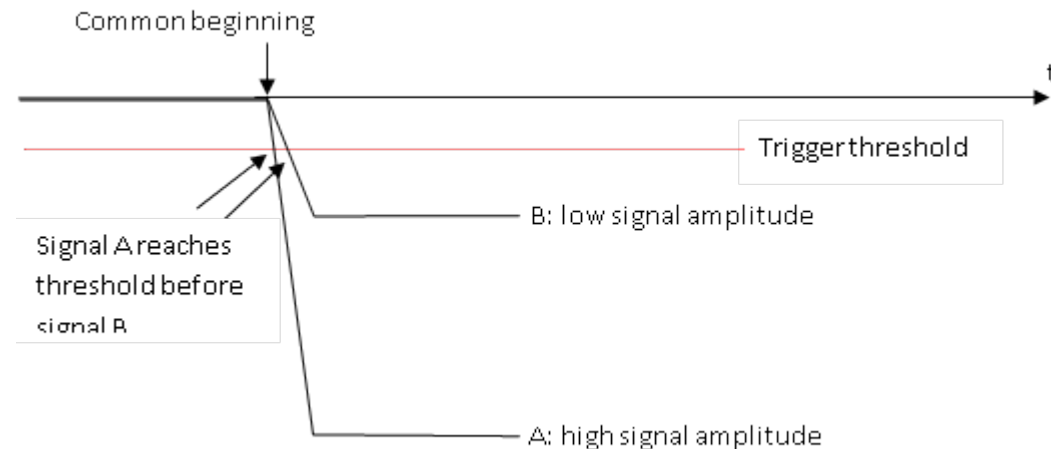
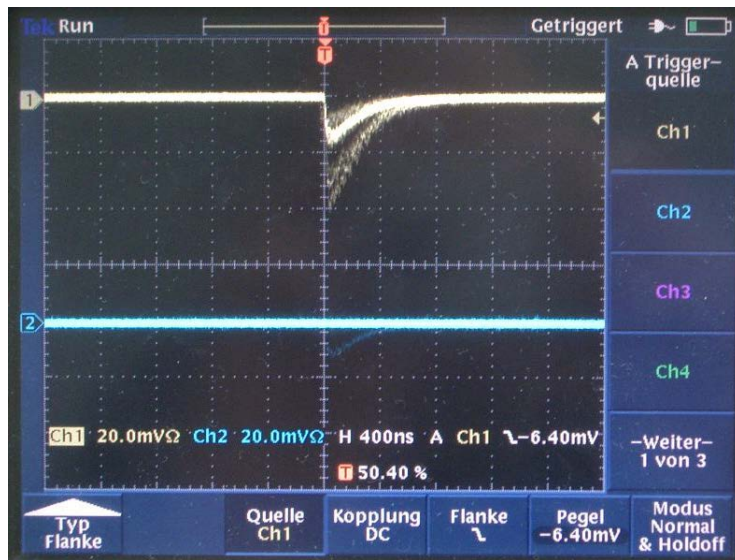
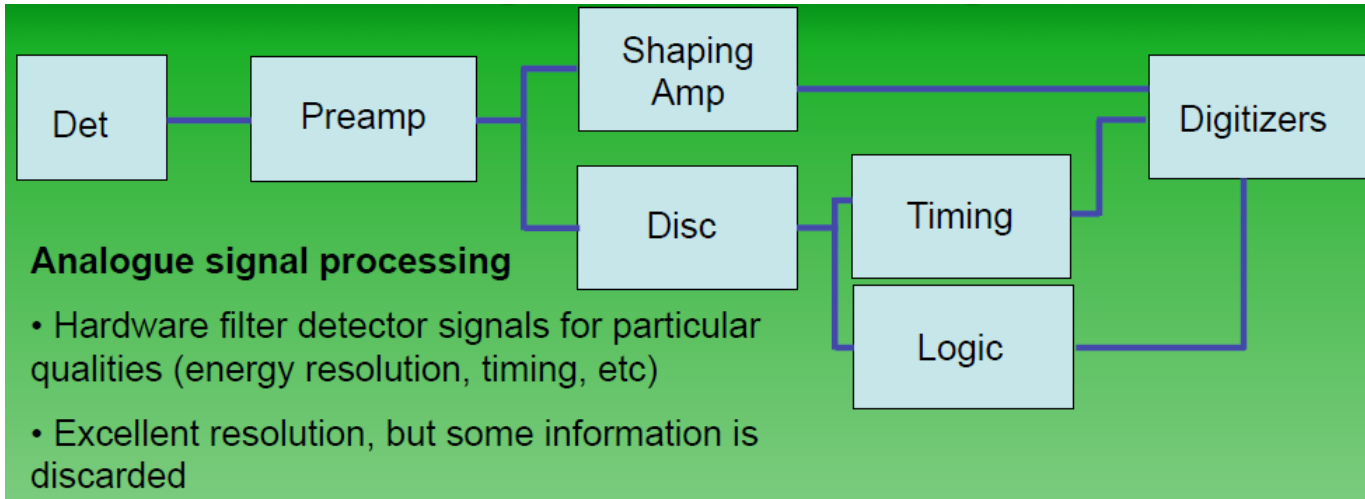
# Shaping amplifier

Shape pulses to:

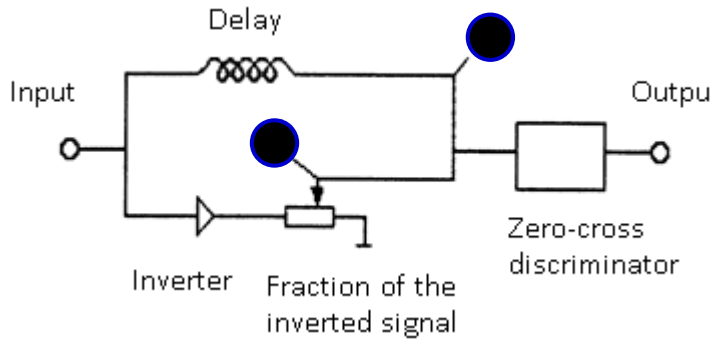
- ❖ Improve signal to noise
- ❖ Reduce pileup effects
- ❖ Keep signal height information
- ❖ Lose shape information



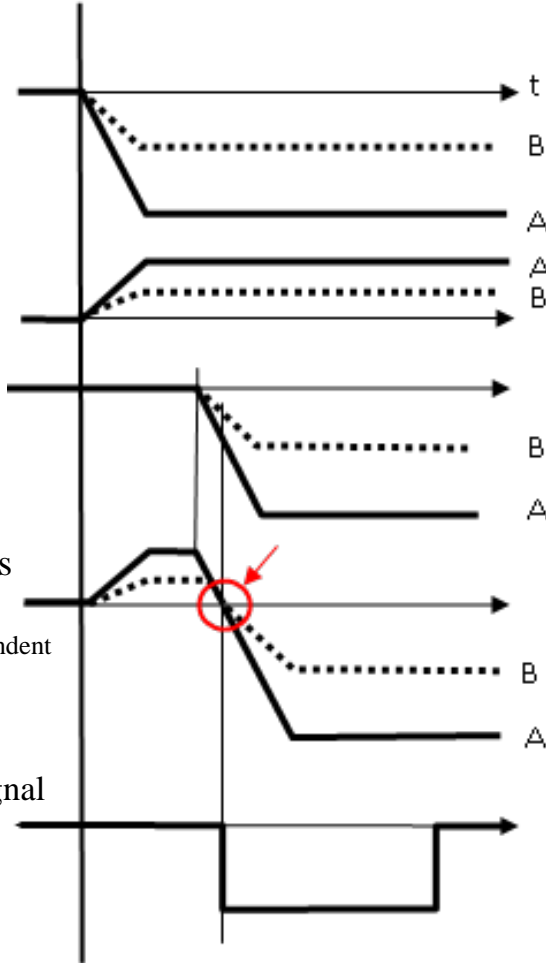
# Signal processing



# Constant Fraction Discriminator



Input signals

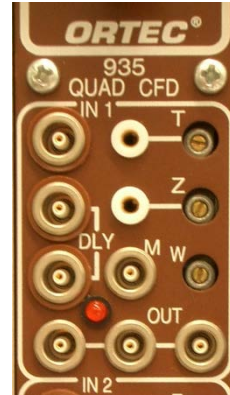


One signal (a) is inverted and attenuated

The other signal (b) gets delayed

Adding of the signals (a) and (b)  
(The zero crossing is independent of the signal amplitude)

Rectangular output signal

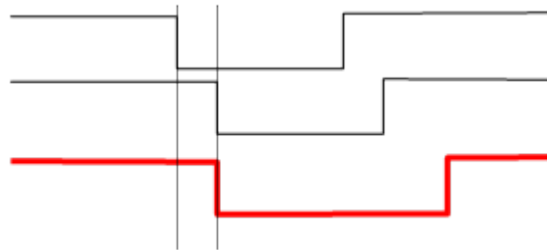


# The coincidence unit

detector 1:

detector 2:

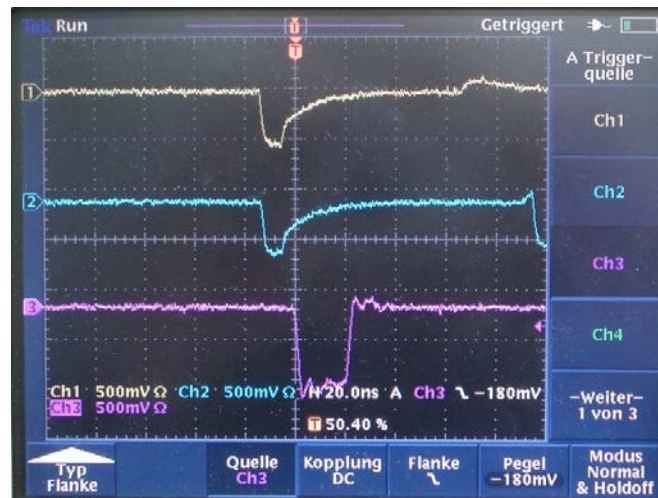
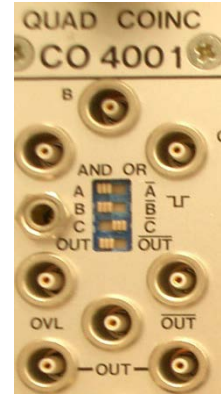
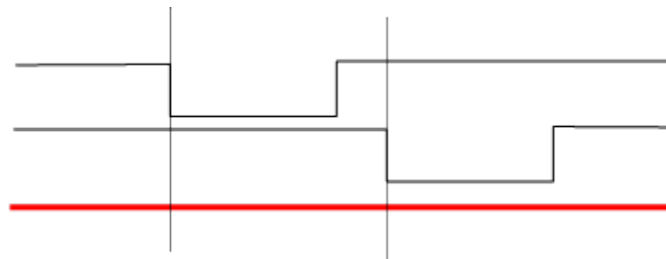
(detector 1) AND (detector 2):



detector 1:

detector 2:

(detector 1) AND (detector 2):



# Coincidence electronic

