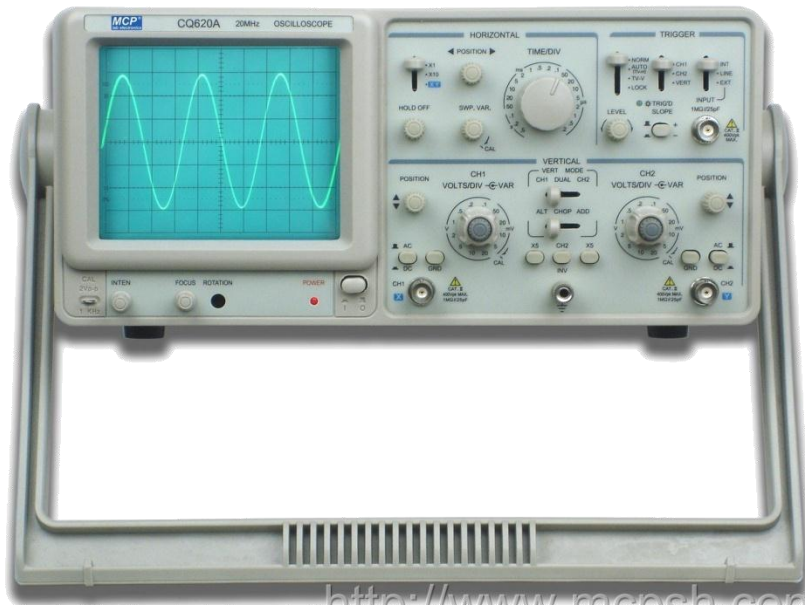


Lecture 12

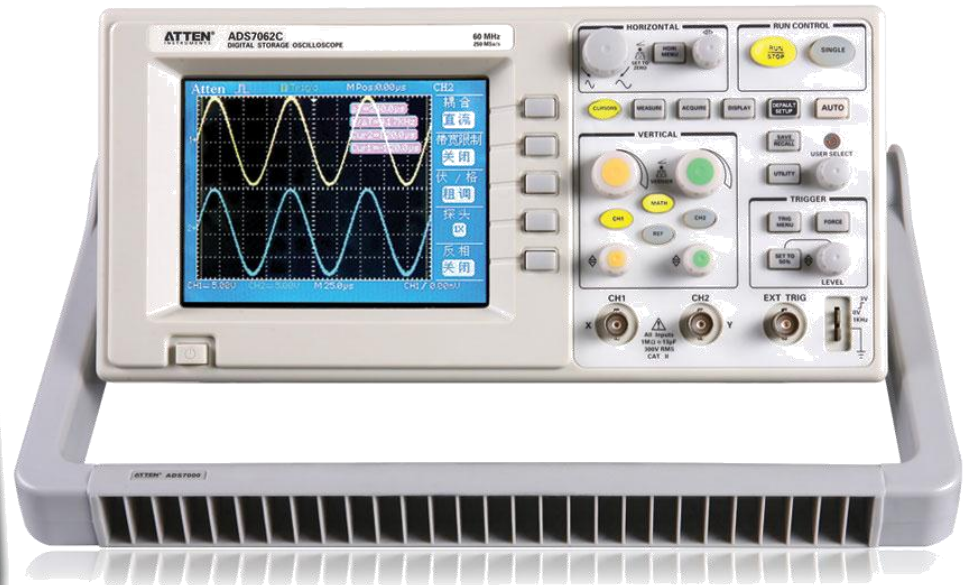
OSCCILOSCOPE

Oscilloscope

Analogue

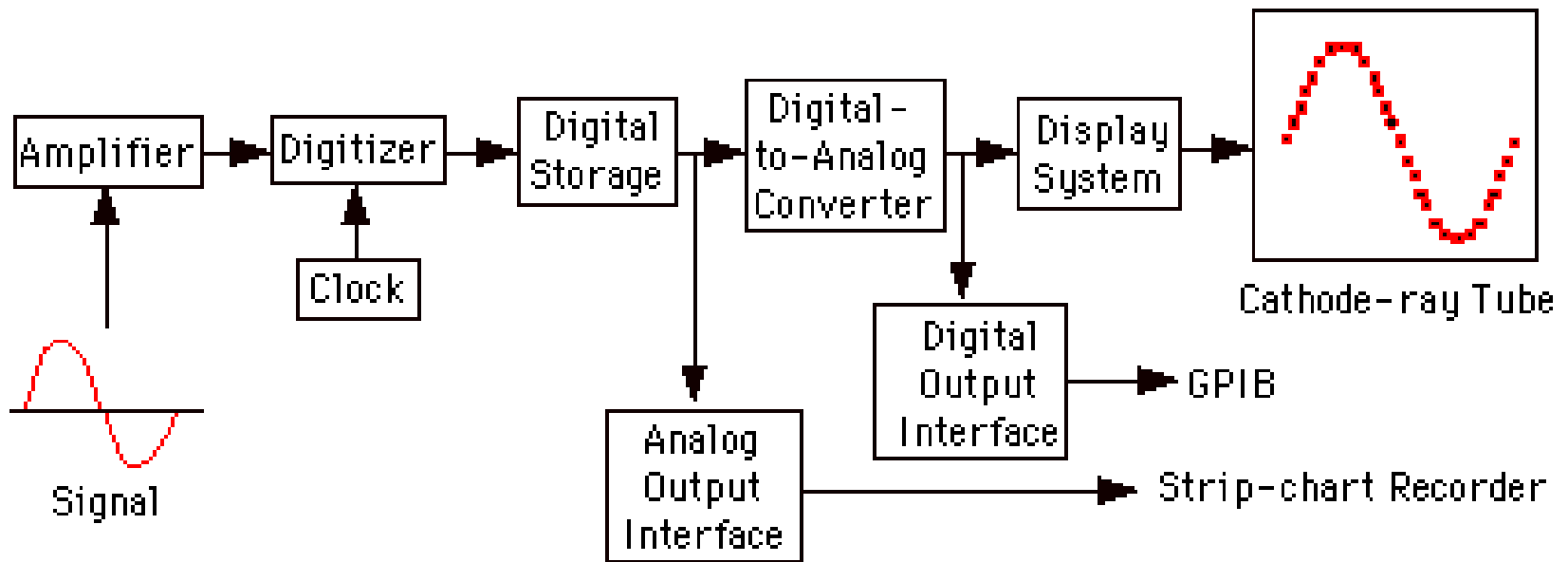


Digital

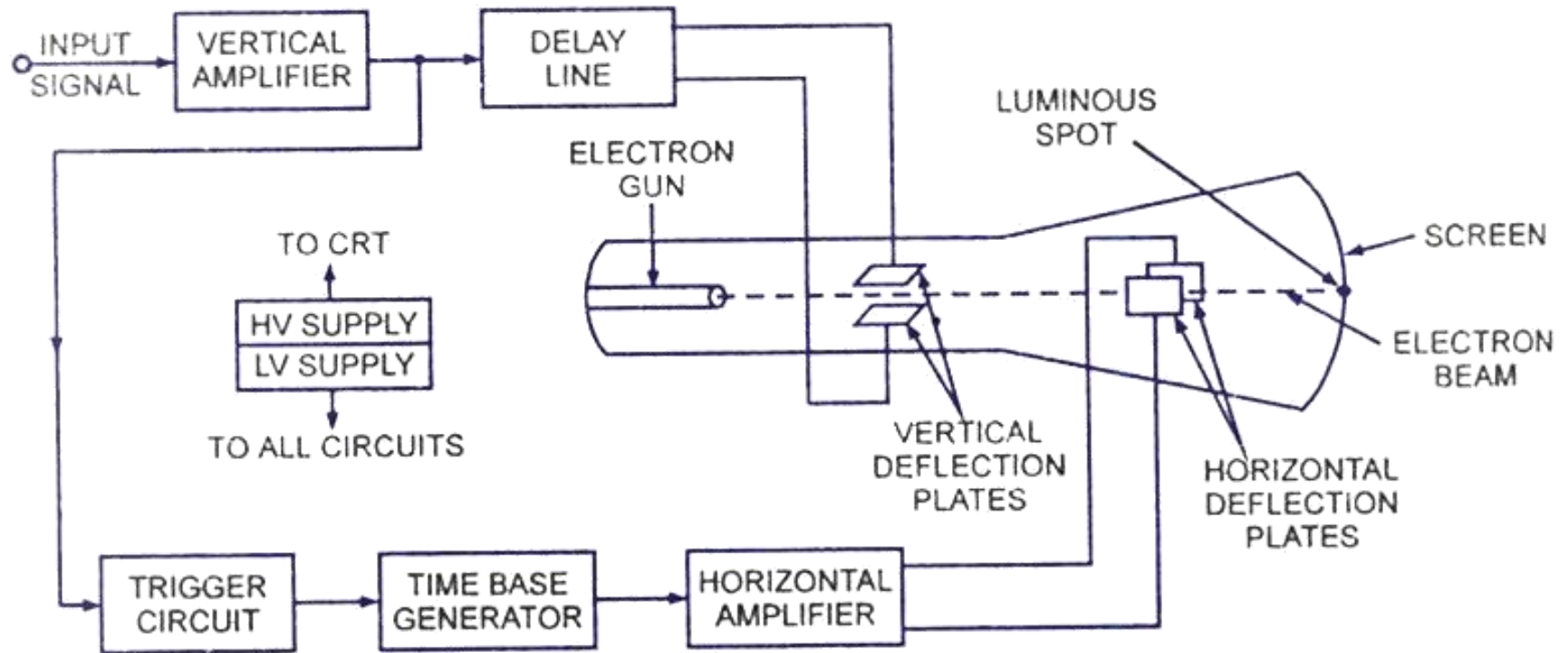


<http://www.mcps.com>

Oscilloscope



OSCCILOSCOPE – Block Diagram

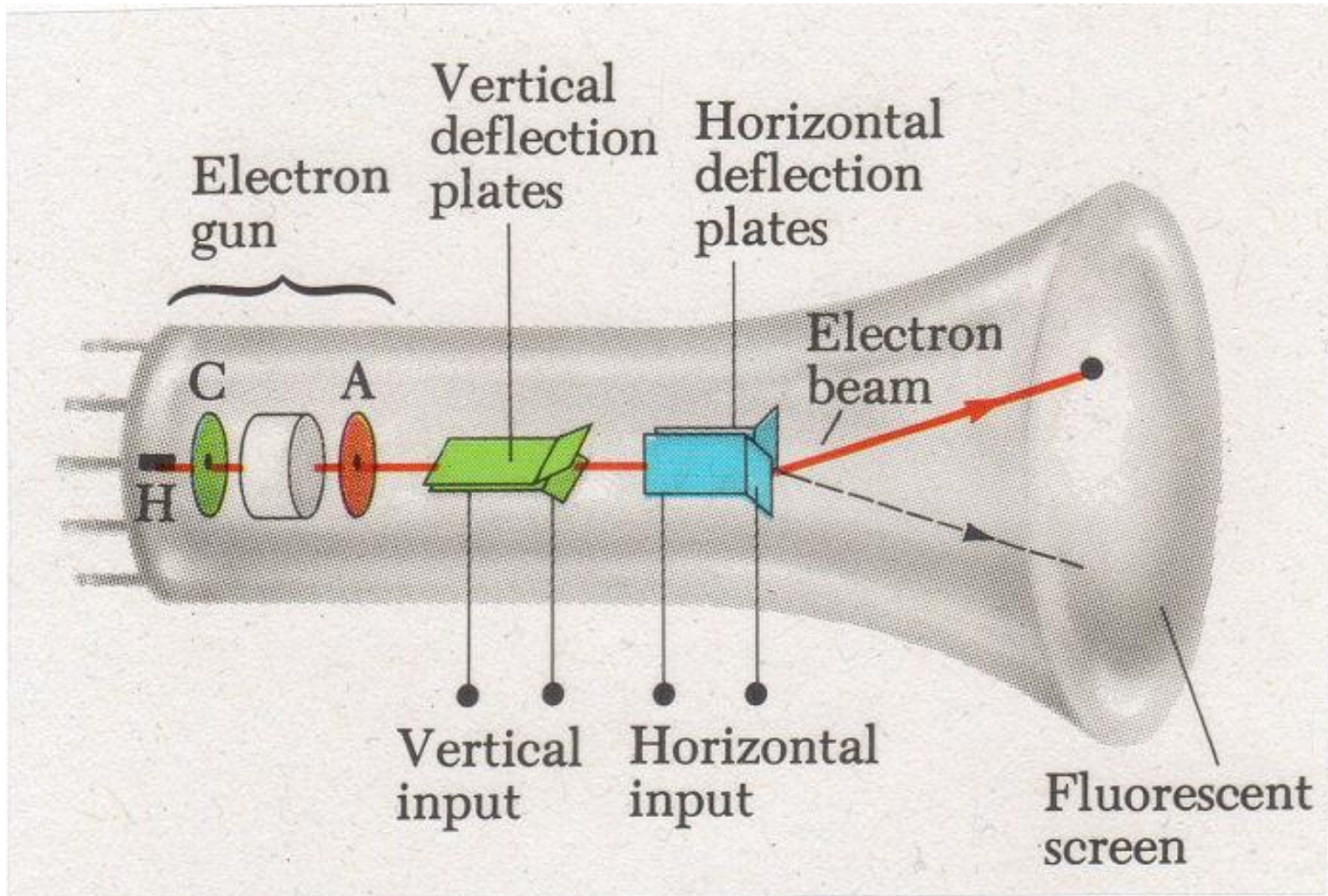


Block Diagram of a General Purpose CRO

OSCCILOSCOPE – Parts

- Cathode Ray tube
- Vertical Amplifier
- Horizontal Amplifier
- Time Base(sweep) Generator
- Trigger Circuit
- Delay Line
- Screen

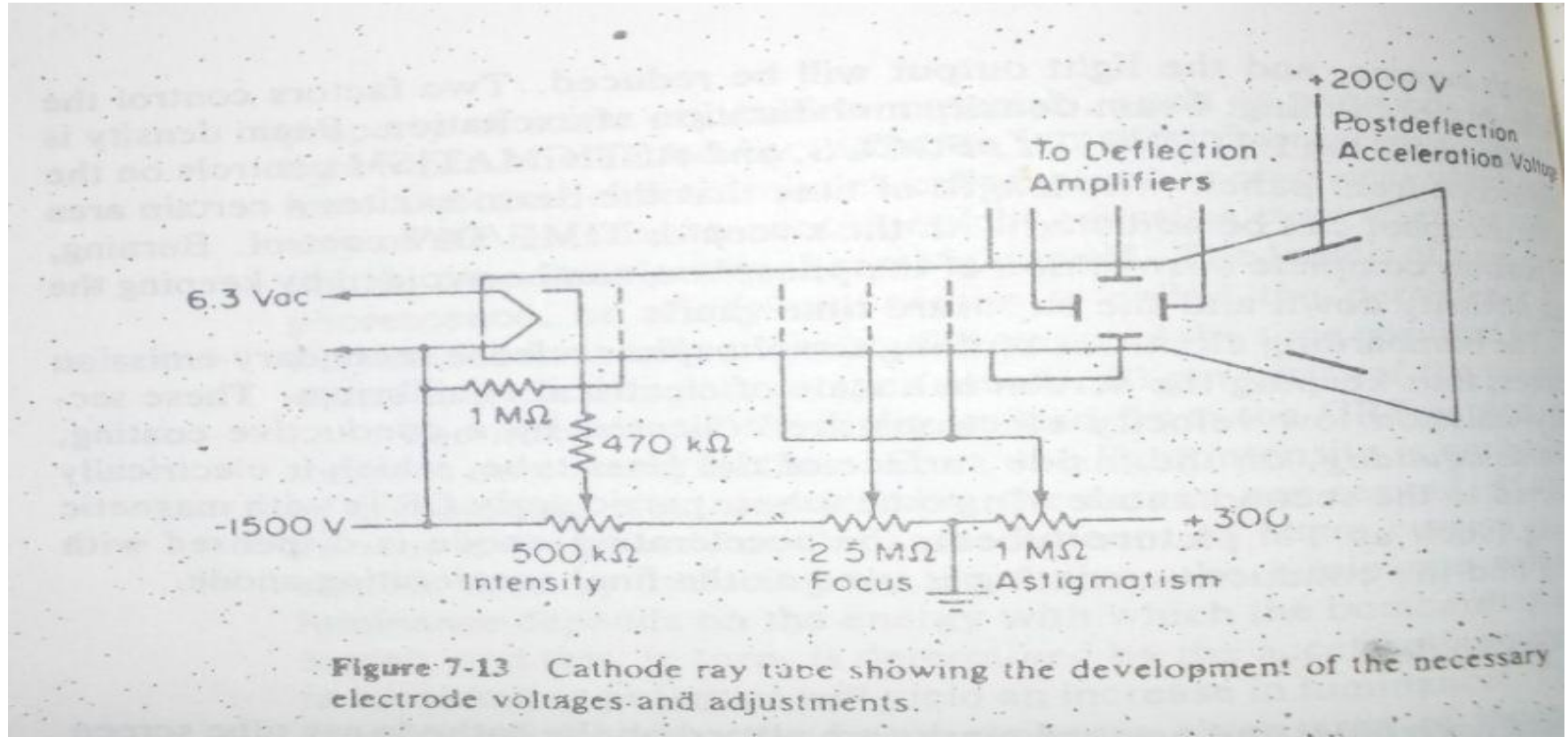
Cathode Ray Tube



Cathode Ray Tube

- Electron Gun
 - Cathode
 - Focusing System
 - Anode(Accelerator)
- Horizontal Deflection Plates
- Vertical Deflection Plates
- Fluorescent Screen

Cathode Ray Tube



Cathode Ray Tube

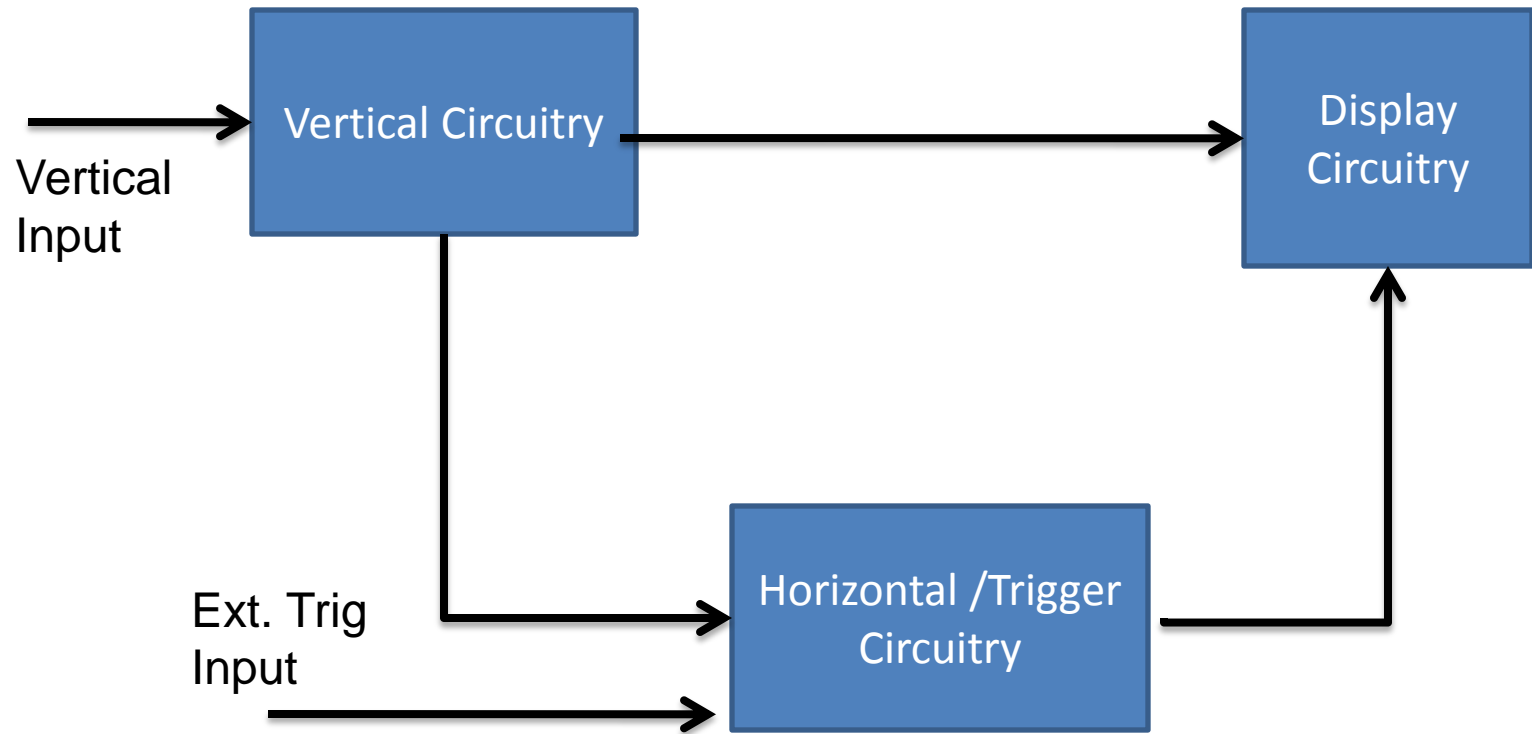
- The first requirement is a low voltage source for the cathode heater.
- Very few of the elements of the cathode ray tube require any significant power, and the required operating voltages are derived from simple voltage divider, as shown in Fig 7-13.
- Three controls are associated with the operating voltages of the cathode of the cathode ray tube
 - Intensity
 - Focus
 - Astigmatism
- The **astigmatism** control adjusts the potential between the deflection plates and the first accelerating electrode and is used to produce a round spot.

Graticule

- **A network of lines representing meridians and parallels, on which a map or plot can be represented**
- Calibrated horizontal and vertical marks are placed on the cathode ray tube screen
- The accuracy of these marks depends on how close the graticule marks can be placed to the actual phosphor to eliminate parallax.
 - Early oscilloscope tubes used an external graticule to provide the necessary marks, but the distance between the marks on the graticule and the actual phosphor coating could be nearly 1 cm, which cause measurement errors if not glass of the cathode rays tube, the distance separating the phosphor and the graticule is nearly zero and parallax errors are practically nonexistent.

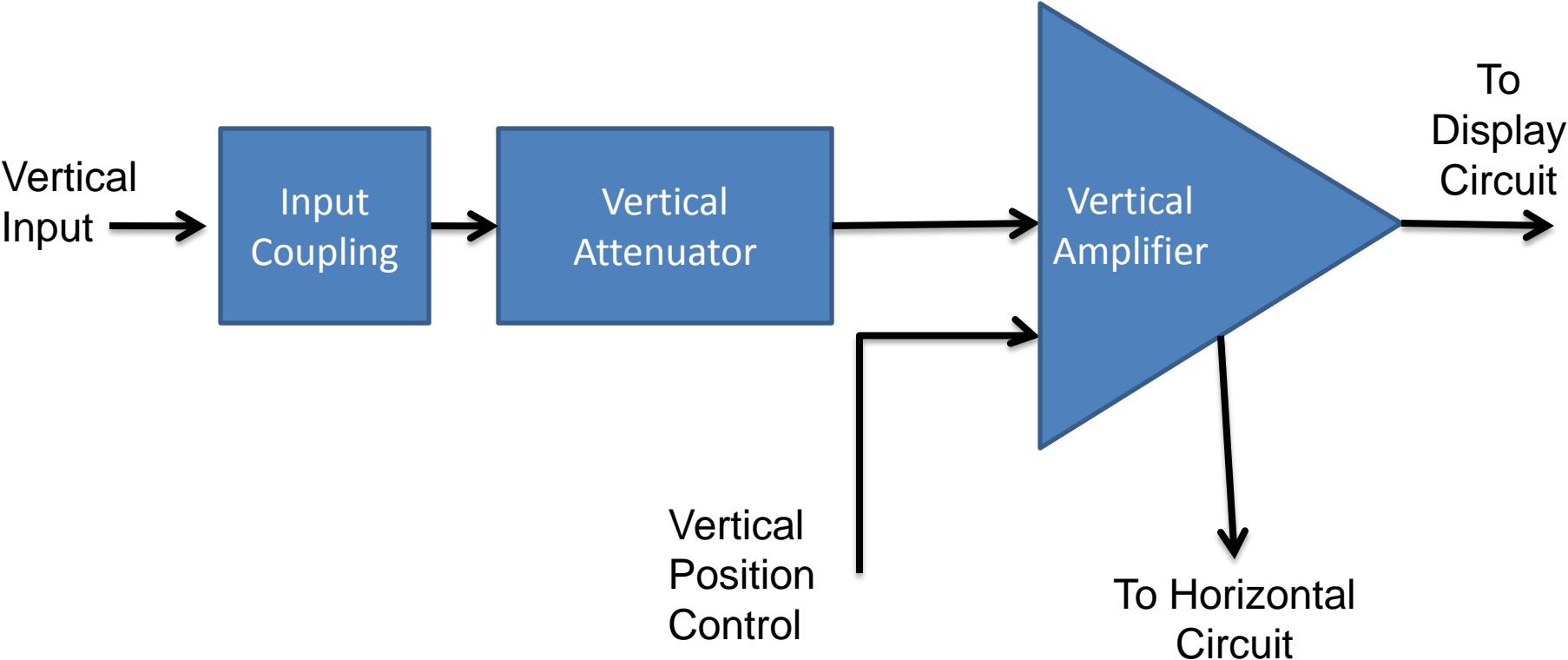
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OSCILLOSCOPE – Block Diagram



Simplified Oscilloscope Block Diagram

OSCILLOSCOPE – Vertical Circuitry

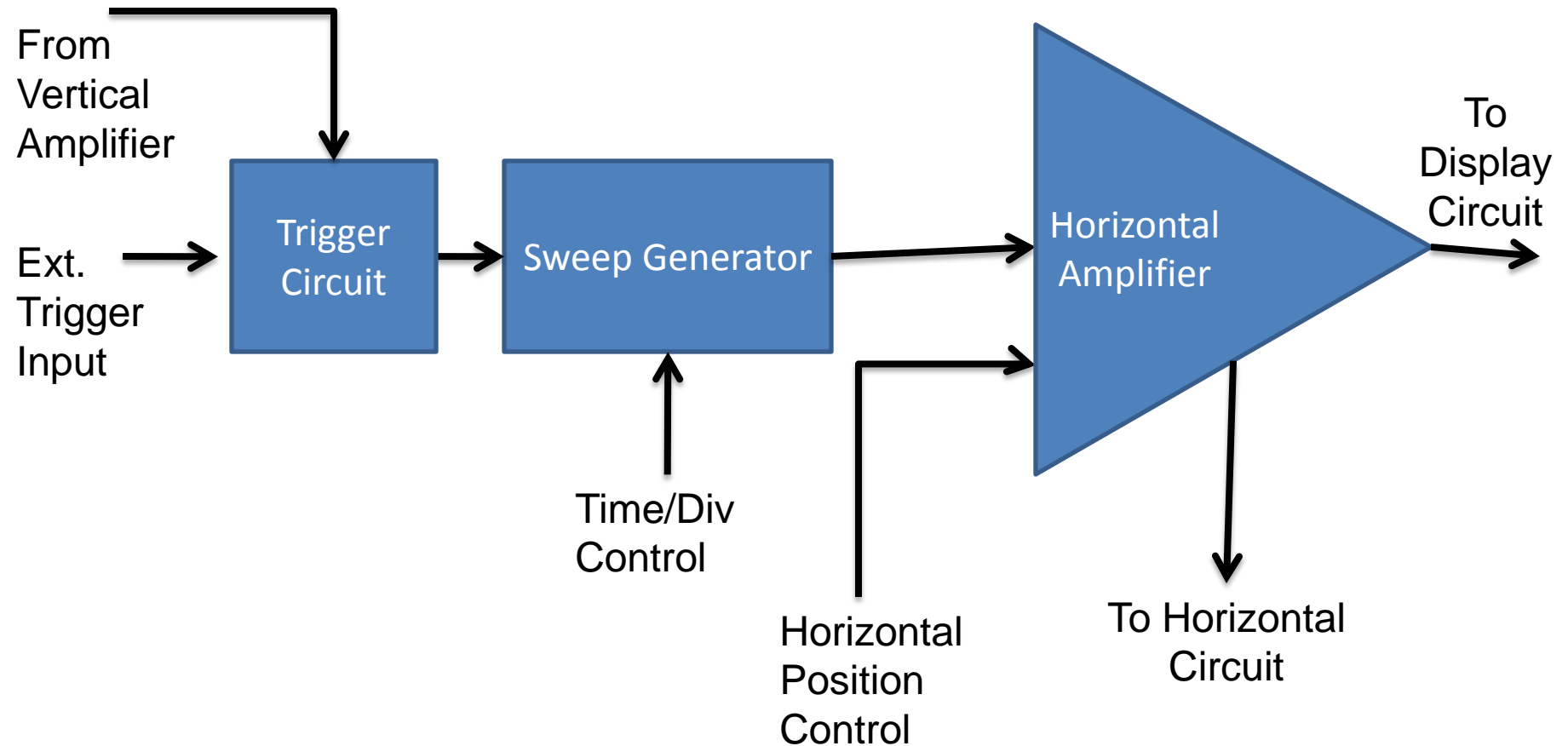


Vertical Circuitry Oscilloscope Block Diagram

Vertical Circuitry

- The function of the vertical deflection is to provide an amplified signal of the proper level to drive the vertical deflection plates without introducing any appreciable distortion into the system
- Consists of
 - Input Coupling
 - Input Attenuator
 - Vertical Position Control Input
 - Push-pull Amplifier
 - Output to Horizontal/Trigger Circuitry
 - Output to deflection vertical deflection plates

OSCILLOSCOPE – Horizontal Circuitry



Horizontal/ Trigger Circuitry Oscilloscope Block Diagram

Horizontal Circuitry

- Its purpose is to deflect the horizontal portion of the trace at a constant rate relative to time, which is often referred to as linear sweep.
- The **time base generator** control the rate at which the beam is scanned across the face of the cathode ray tube and is adjusted from the front panel.
- The **trigger circuit**, insures that the horizontal sweep starts at the same point of the vertical input signal.
- The **horizontal amplifier** is similar to the vertical amplifier is required to increased the amplitude of the signals generated in the sweep generator to the level required by the horizontal deflection plates of the cathode ray tube.

Horizontal Circuitry- Sweep Generator

- The **sweep generator** uses the charging characteristics of a capacitor to generate linear rise time voltages to feed to the horizontal amplifier. Fig 7-28 shows a capacitor being charged from a constant current source. The rate of voltage rise is given as
- Charge of voltage/time= I/C

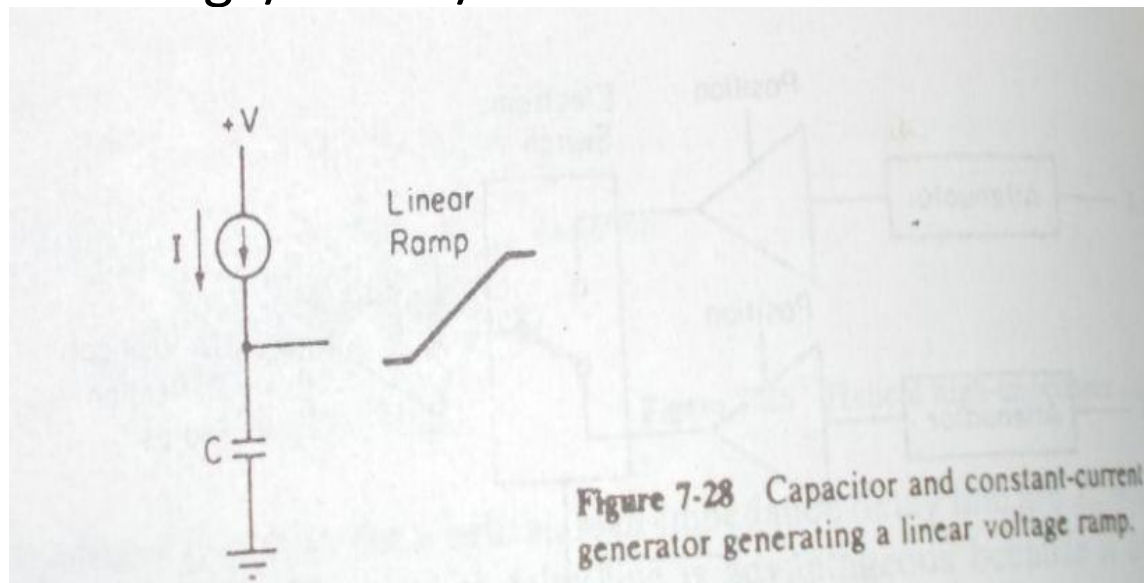


Figure 7-28 Capacitor and constant-current generator generating a linear voltage ramp.

Delay Line

- Delay in oscilloscope is created in circuit that switch, shape, or generate.
- Comparing the vertical and horizontal deflection circuits, we observe that the horizontal signal (time base or sweep voltage) is initiated, or triggered, by a portion of the output signal applied to the vertical CRT plates.
- Signal processing in the horizontal channel consists of generating and shaping a trigger pulse (trigger pickoff) that starts the sweep generator, whose output is fed to the horizontal amplifier and then to the horizontal deflection plates. This whole process takes time: on the order of 80 ns or so.
-

Delay Line

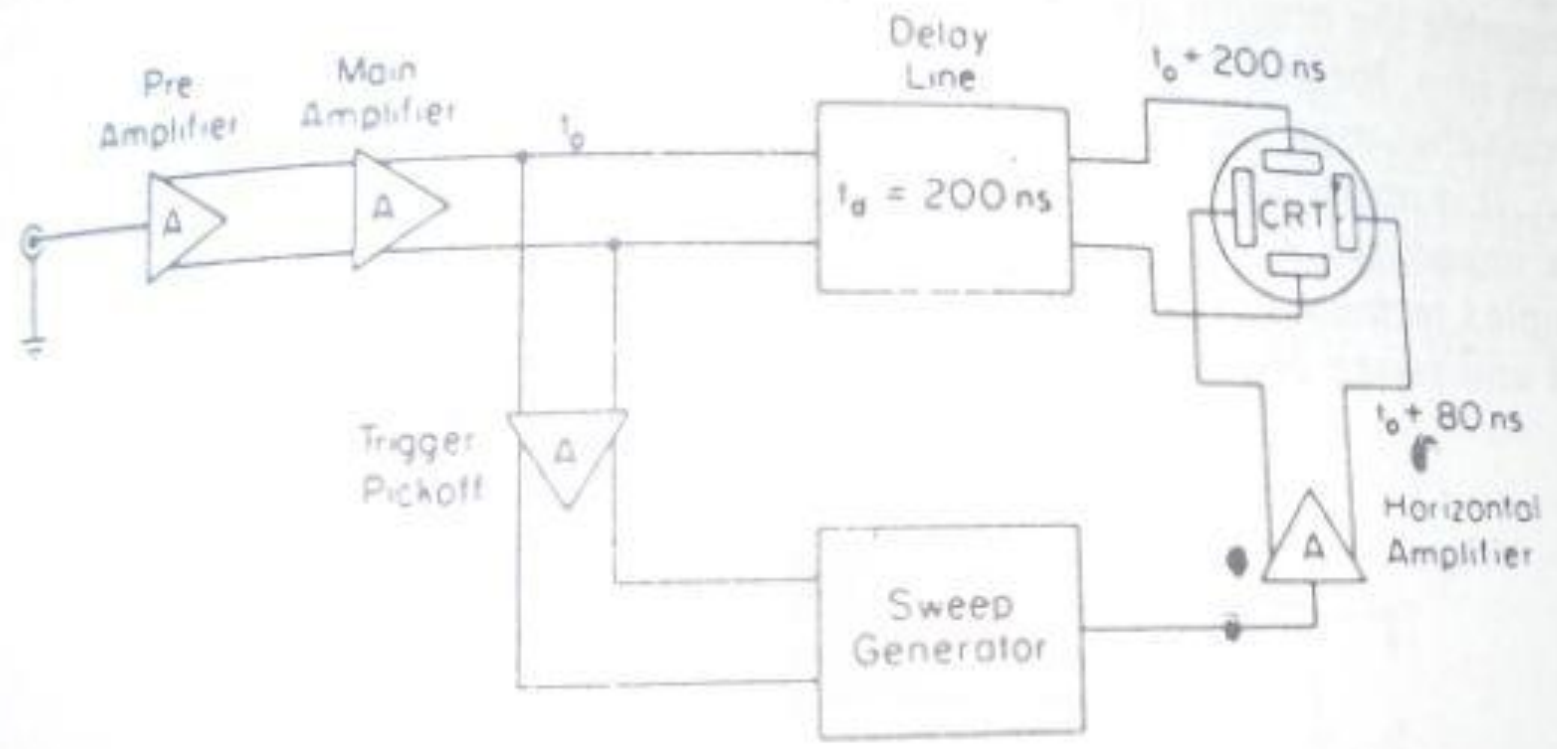


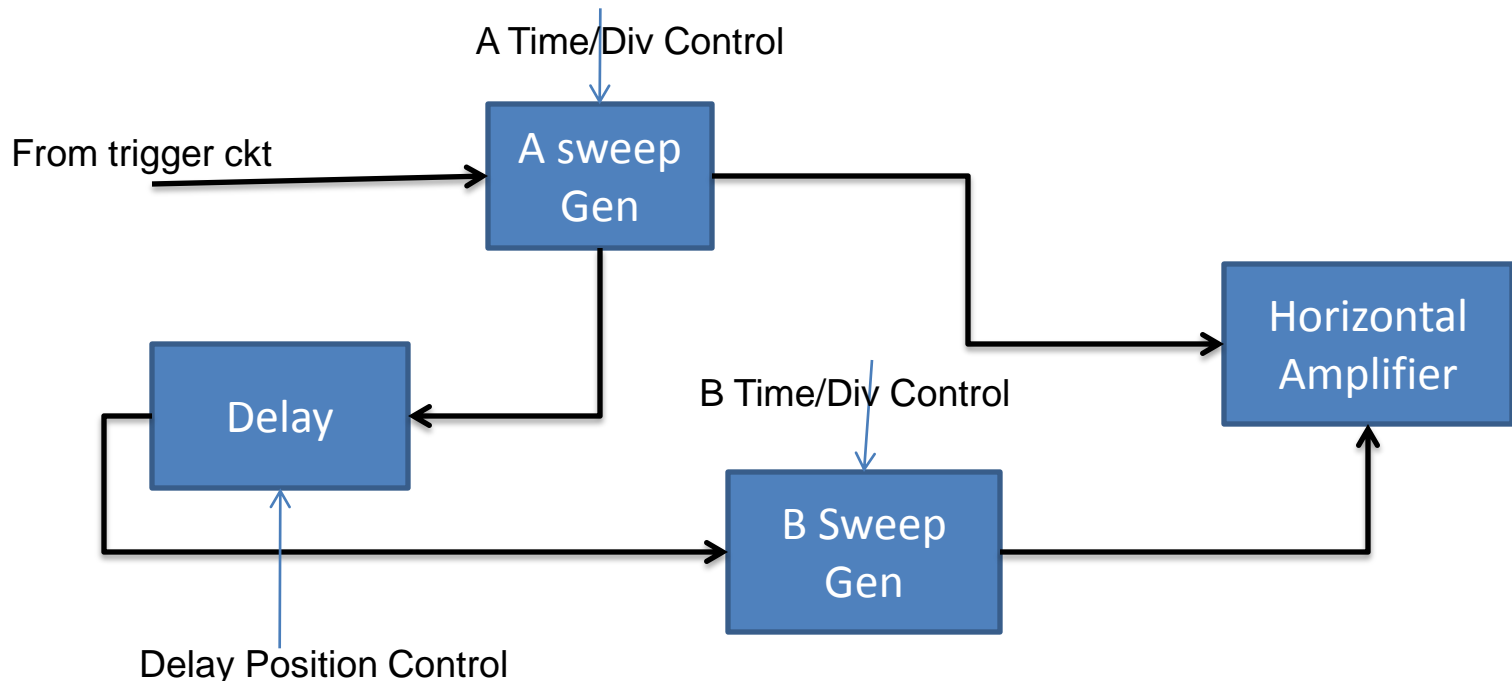
Figure 7-22 Delay of the vertical signal allows the horizontal sweep to start prior to vertical deflection.

Delay Line

- To allow the operation to observe the leading edge of the signal waveform, the signal drive for the vertical for the vertical CRT plates must therefore be delayed by at least the same amount of time. This is function of the vertical delay line.
- As a 200 ns delay line has been added to the vertical channel, so that the signal voltage to the CRT plates is delayed by 200 ns, and the horizontal sweep is started prior to the vertical deflection. Although the delay line can appear almost anywhere along the vertical signal path, the trigger pickoff must precede the delay line.
- There are basically two kinds of delay line:
 - the lumped parameter delay line
 - the distributed parameter delay line

Magnification in Oscilloscope

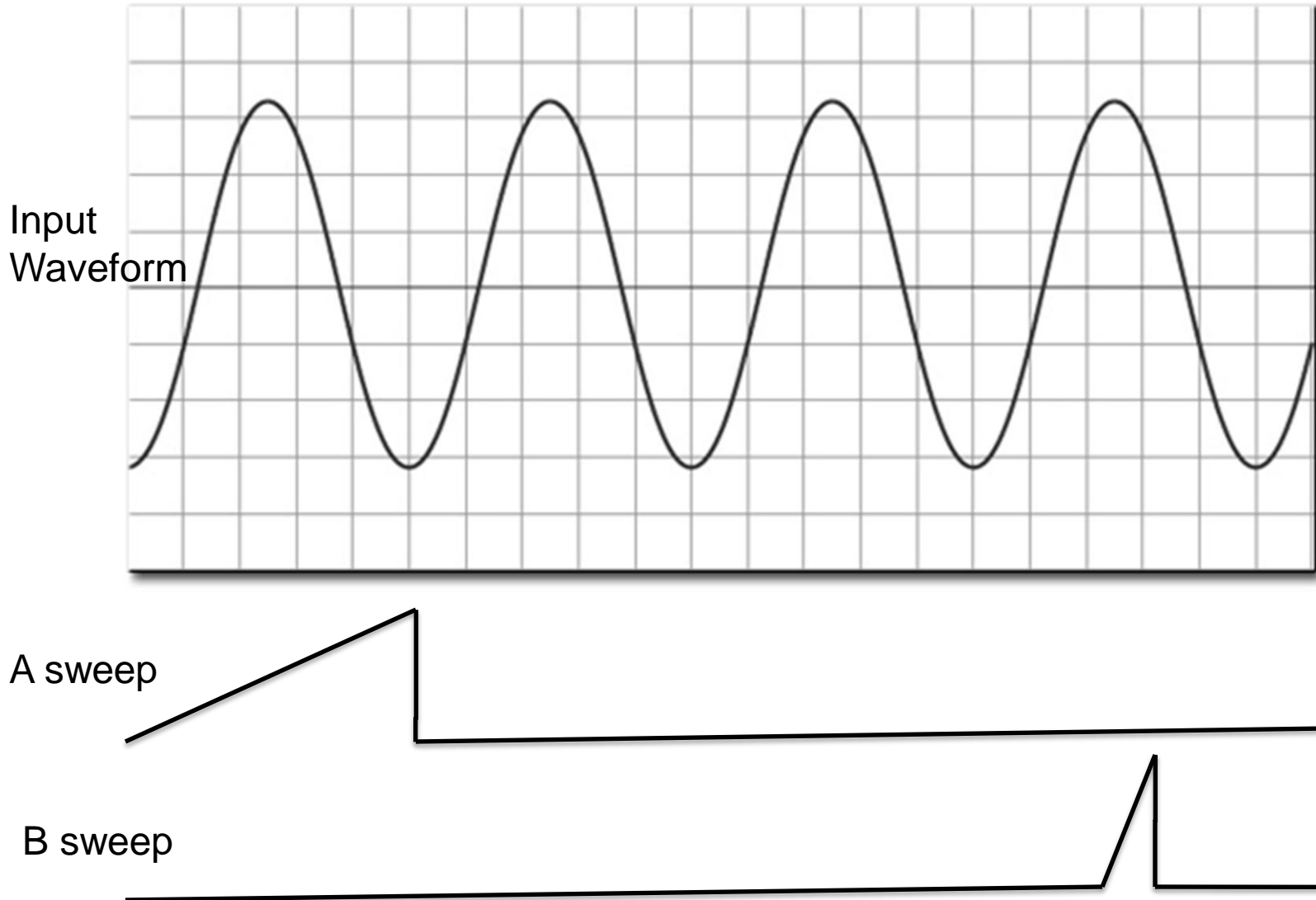
- Delayed sweep allows a portion of the trace to be magnified.
- The original sweep is referred to as sweep A and the magnified trace as sweep B.



Magnification in Oscilloscope

- The trigger starts the A sweep generator and several cycles of the input are displayed
- The trigger is also applied through a variable delay network which starts the B sweep generator at a later point.
- When the B sweep starts the display is switched to view the faster B sweep for balance of the trace.
- Since B sweep is faster, that portion of the waveform is expanded.

Magnification in Oscilloscope



Digital Storage Oscilloscope

- Basic functionality of DSOs is that they can even store the data observed on the screen of oscilloscope.
- Additional Components
 - Analogue to Digital Converter
 - Memory
 - Digital to Analogue Converter
 - Control Logic(Microprocessor, Address Counter, etc)

Digital Storage Oscilloscope

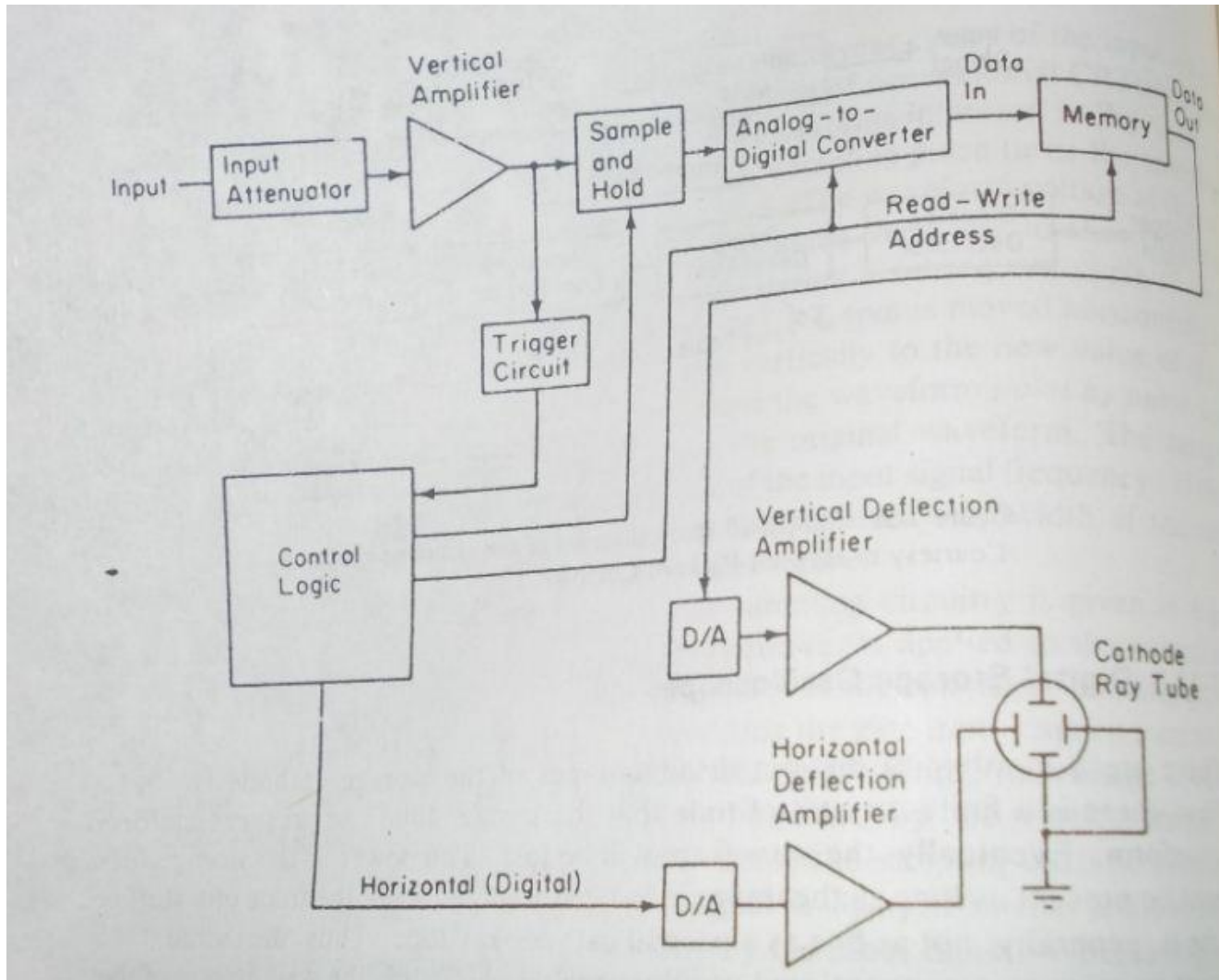


Figure 7-52 Block diagram of a digital storage oscilloscope.

Thank you