Ministry of Higher Education and Scientific Research
Al-Mustaqbal University College
Radiology Techniques Department

Radiology Equipment Techniques

Al-Mustaqbal University College

2nd Class

Radiology Techniques Department

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MS.C. Theoretical Physics

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Practical 4 : Types of Transducer and Ultrasound Equipment

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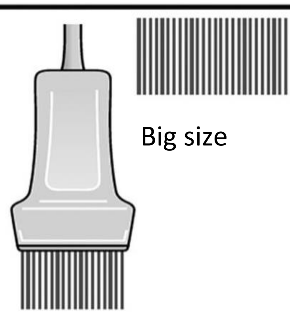
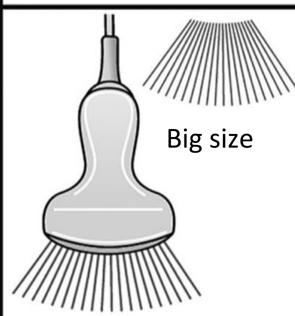
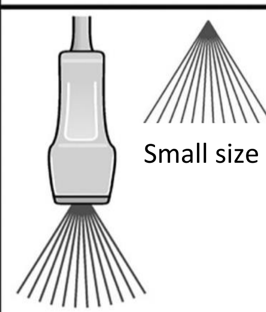
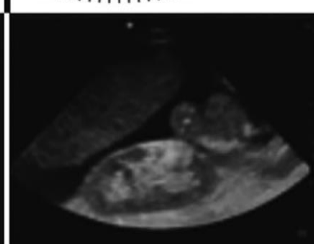
The ultrasound transducers differ in construction according to:

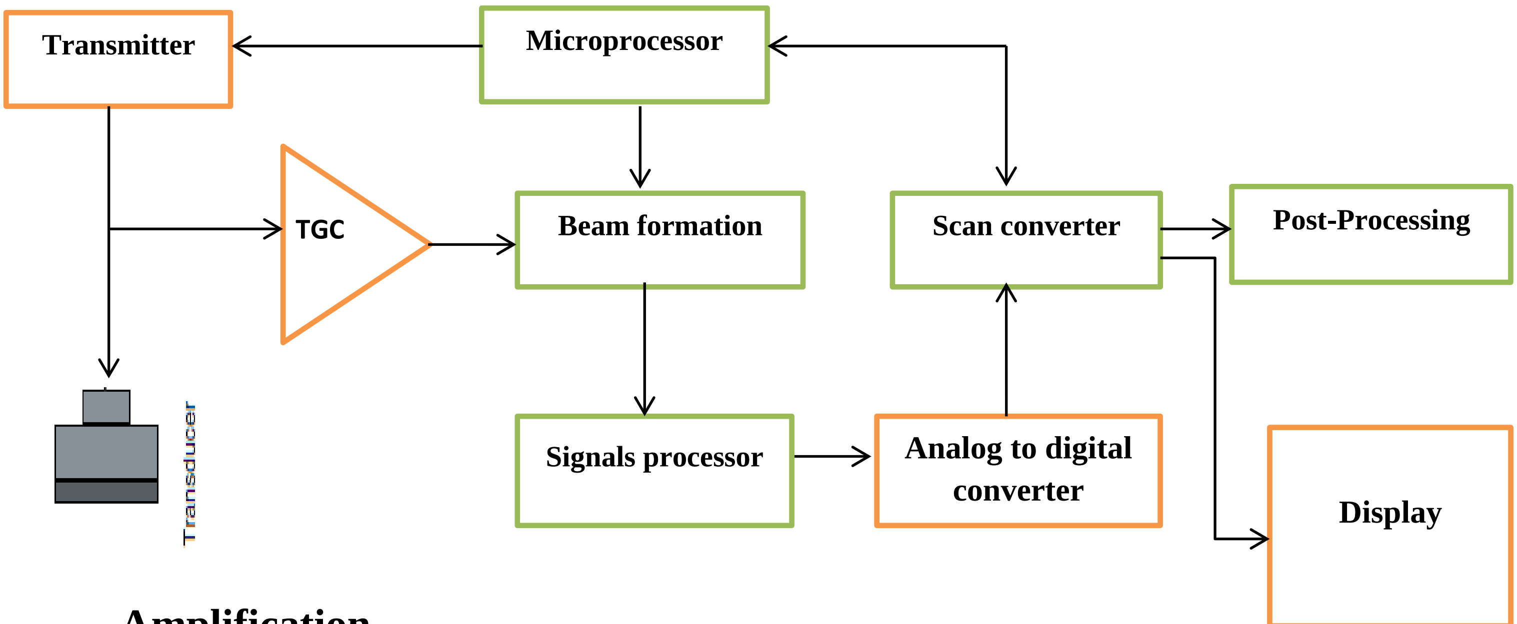
1. Piezoelectric crystal arrangement
2. Aperture (footprint)
3. Operating frequency (which is directly related to the penetration depth)

There are three types of transducers that most often used in the critical ultrasound imaging: Linear, Sector(curvilinear) and Convex(phased)_

Transducer type	Linear	Curvilinear	Phased array
			
Frequency range	5–10 MHz	2–5 MHz	1–5 MHz
Imaging depth	9 cm	30 cm	35 cm
Footprint			
Image			
Applications	Arteries/veins Procedures Pleura Skin/soft tissues Musculoskeletal Testicles/hernia Eyes Breast	Gallbladder Liver Kidney Bladder Abdominal aorta Abdominal free fluid Uterus/ovaries	Heart Inferior vena cava Lungs Pleura Abdomen

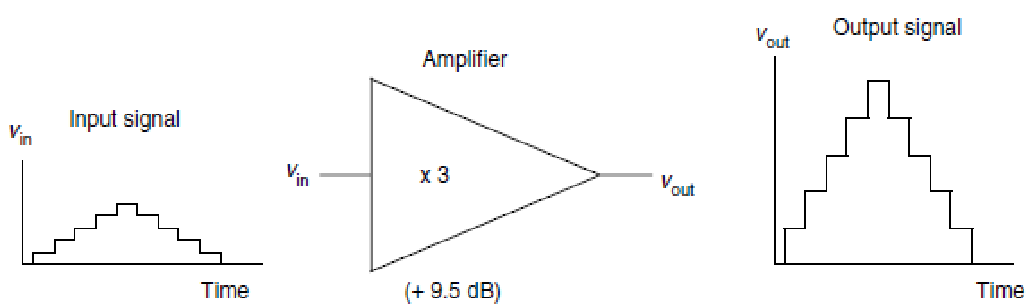
Ultrasound Equipment

Figure below illustrates, block-diagram form, the essential elements of the complete ultrasound system, and shows information is processed in various ways before storage in the image memory, from where the image is displayed.



Amplification

The echo signals generated at the transducer elements are generally too small in amplitude to be manipulated and displayed directly and need to be amplified (made bigger).



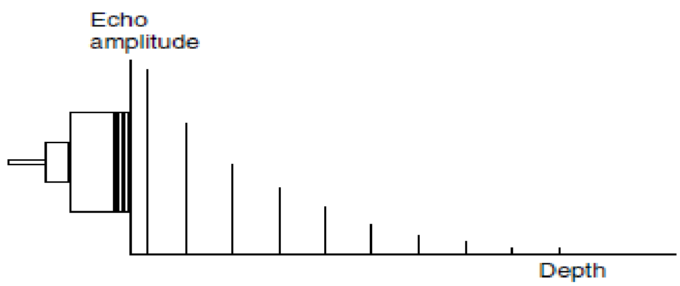
Transmit power control

Most ultrasound imaging systems allow user control of the output transmit power by the transducer. This control is often labeled as ‘transmit power’

Time–gain compensation

Attenuation

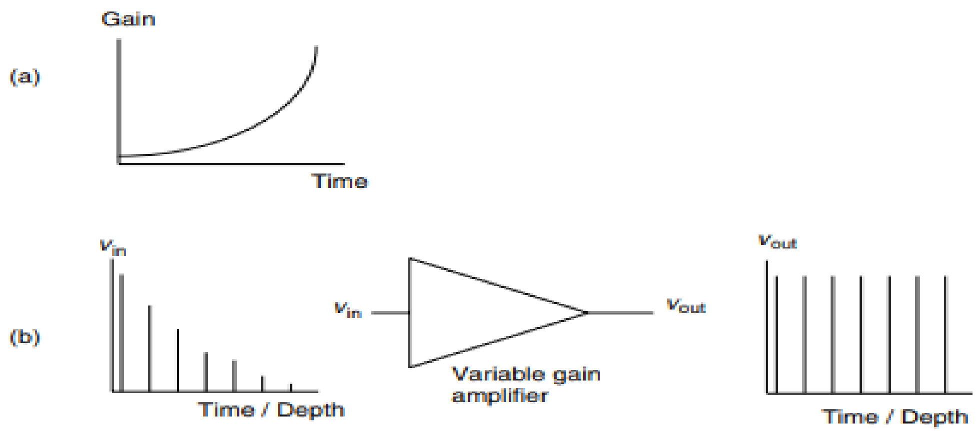
when a transmitted ultrasound pulse propagates through tissue, it is attenuated (made smaller). Echoes returning through tissue to the transducer are also attenuated. Hence, an echo from an interface at a large depth in tissue is much smaller than that from a similar interface close to the transducer



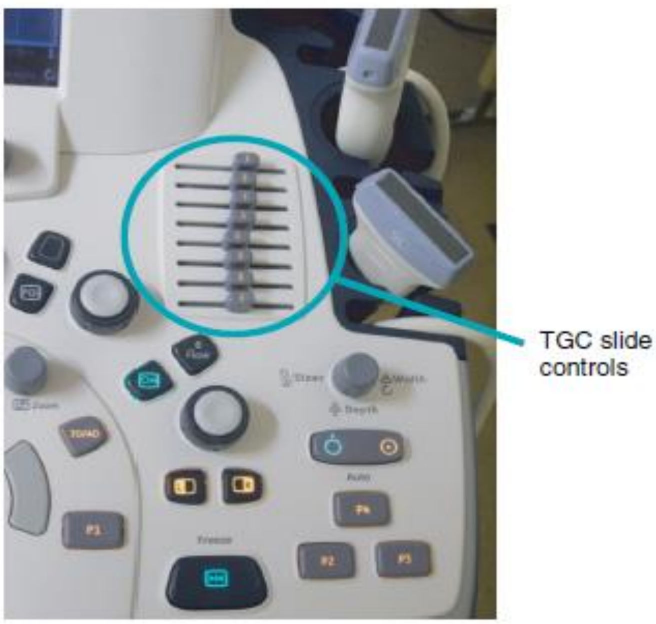
Time–Gain Control

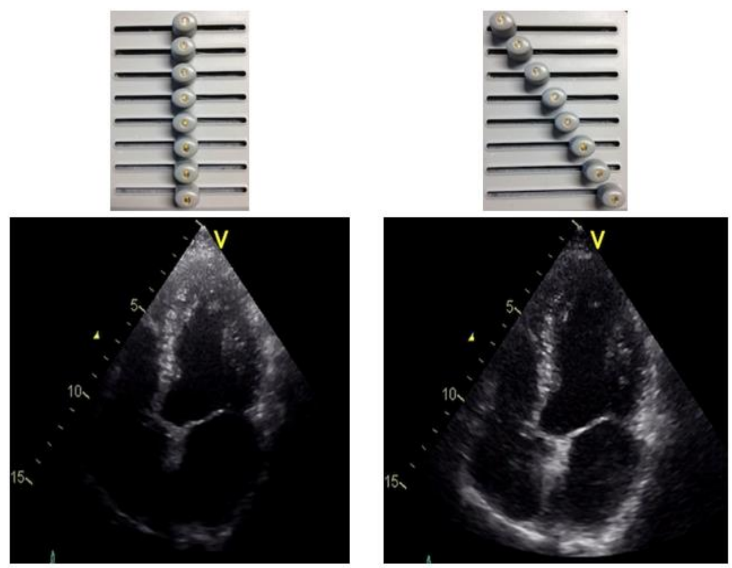
It is necessary to compensate for this attenuation by amplifying echoes from deep tissues more than those from superficial tissues

- This effect can be achieved by increasing the amplification of echo signals with time. The technique is most commonly called **Time–Gain Compensation (TGC)**



- The most common arrangement for manual TGC adjustment is a set of slide controls as illustrated in Figures below . Each slide alters the gain of the TGC amplifier at specific times after transmission,
- i.e. for echoes returning from a specific range of depths within the tissue.





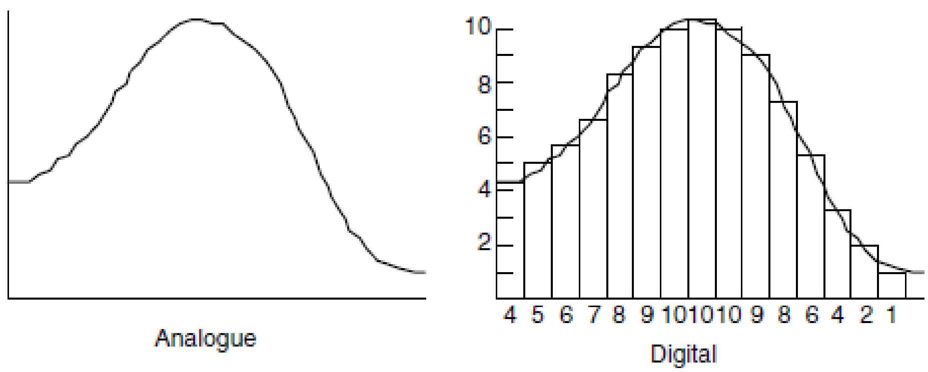
- Moving the top slide to the right increases the gain applied to echoes from superficial tissues.
- The bottom slide adjusts the gain applied to the deepest echoes.

The differences in reflected echo strength between different tissues is crucial to the interpretation of the image.

Analogue-to-Digital Conversion

The echo signals received by the transducer elements are analogue signals. That is, their amplitudes can vary continuously from the smallest to the largest value.

- The echo signal must be converted from analogue to digital form. The conversion process is illustrated in figure below



- The input to the ADC is an analogue signal whose amplitude varies continuously with time, and the output is a corresponding stream of binary numbers as illustrated in figure below.