

## The implementation of PC-based instrumentation for Underwater Acoustic communication system, -

→ Acoustic waves → FSK communication protocol is used  
communication information modulated into waveform with different frequencies combination.

→ wave library is created by waveform editor  
↳ wave form inf about amp, duration, freq

while performing  
command modulation

After the <sup>Entire</sup> commands being typed waveform information is  
sent out through PC (function generation) & then amplified  
& transmitted through a regular UWA Projector

Remodulation is takes place in system

Embedded controller. [microcontroller in computers that  
handle various system tasks that the operating system  
does not handle]

→ Demodulation of signals, command identification & operation

After receiving the acoustic inf from hydrophone

FFT to identify proper frequency information

which is then mapped to the ASCII code to complete communication process

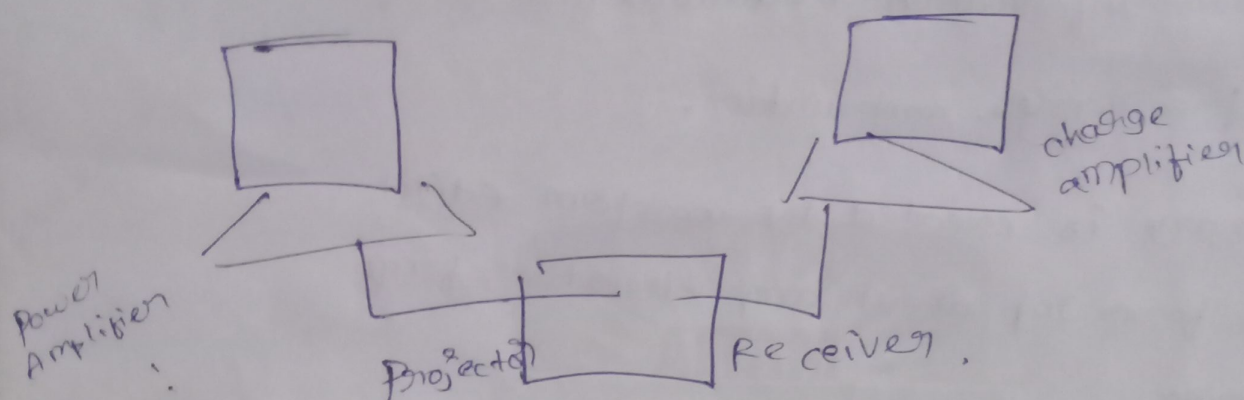
American standard code for  
information interchange

2 parts

1st

modulation module  
acoustic projector at the  
command port

2nd  
demodulation  
module  
receiving hydrophone



~~Embed~~ Embedded controller

Projector/Receiver → signal transmission / receiving

Power Amplifiers → for projector use

charge " → for hydrophone use

Pc controller → command modulation into frequency combination

func generation  
Pc based func generation

arbitrary → generates square waveform  
wave generation  
and for transmission

fast transmission → DPSK, QPSK



# Design of Analog-to-Digital converter Interface for

## hydrophone Applications

### System specifications

To Design of a high dynamic range along interface to connect hydrophone to PC

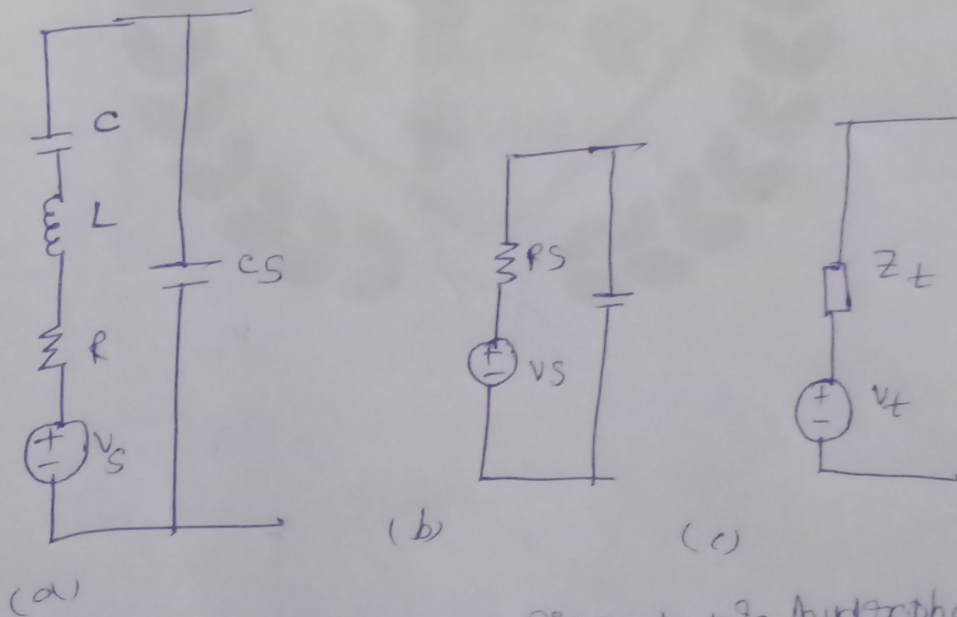
Input : hydrophone

Input signal freq up to 20 kHz

o/p : Real-time freq domain graph in PC

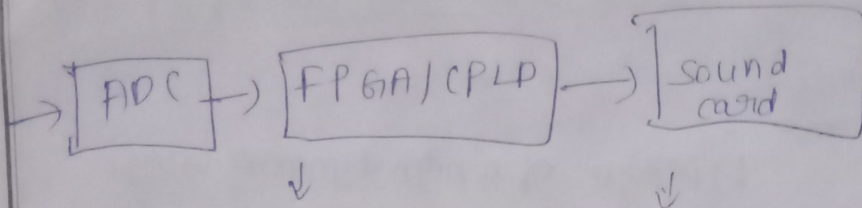
hydrophones made from piezoelectric material

Piezoelectric transducers exhibit high input impedance  
[range from  $10^4$  k $\Omega$  to  $10^5$  M $\Omega$ ]



L) Model of Piezoelectric hydrophone

$C_s$  - capacitance b/w two electrode plates



[Internal expansion card that provides input and output of audio signals to and from a computer under control of computer programs]

Complex programmable logic device

CPLD is used for loading the configuration data of a field programmable gate array from non-volatile memory



Different parameters that need to be taken care of along with signal info while travelling in water.

### Speed of sound in the sea

Sound travels faster in water compared with air. The speed of sound in water is about four times greater than that in air.

Speed of sound in water =  $1500 \text{ m/sec}$

Speed of sound in air =  $343 \text{ m/sec}$

The more the denser the medium the more the speed of sound

Speed of sound  $\boxed{\text{gases} < \text{liquids} < \text{solids}}$

And another important factor for speed of sound is "elasticity"

Speed of ocean is not a homogenous medium and the speed of sound varies from point to point in the ocean. The variation in sound speed is one of the most important characteristics affecting the transmission of sounds. The three main environmental factors affecting the sound speed in the ocean are salinity, pressure & temperature

Salinity:- Salinity, which is on average ranges from 32 to 38 parts per thousand, which is constant in the open ocean. A change in salinity cause a <sup>small</sup> change in density resulting causing variations of sound speed. A change in salinity of one part per thousand will result in a change in sound speed of approximately 1.3 meters per second. Salinity has much smaller effect on speed of sound than pressure & temperature.

Pressure:-

Pressure in sea increases with depth, sound speed increases with depth



Innovate water quality and ecology monitoring using  
underwater unmanned vehicles: Field Applications, challenges  
and feedback from water managers.

<u>underwater drone</u> , <u>location</u>	<u>Depth</u>	<u>communication</u>
Neptune Thunder Tiger, Taiwan	10m	wireless; no real time video/data
Seawolf, Taiwan	15m	wireless, no real time video/data
Open ROV 2.7, USA	100m	Tethered, real time video & navigation data
Power Ray China	70m	"
Blue ROV2 USA	100m	"
Sibiu Nano Spain	100m	"
Blue ROV Heavy, USA	100m	"
Gladius, China	100m	"