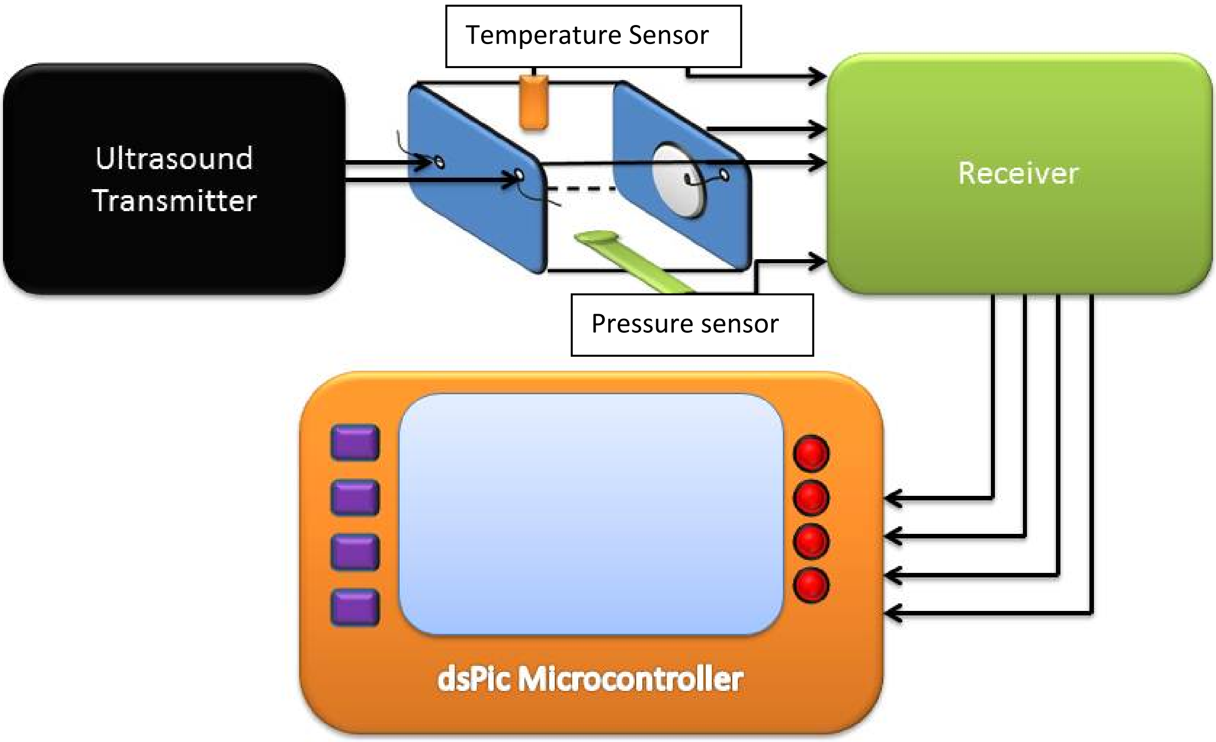
INTEL - ANKUR PROJECT

PROJECT PROGRESS REPORT

The Explanation of the proposed milk analyser is presented here with the complete circuit description.

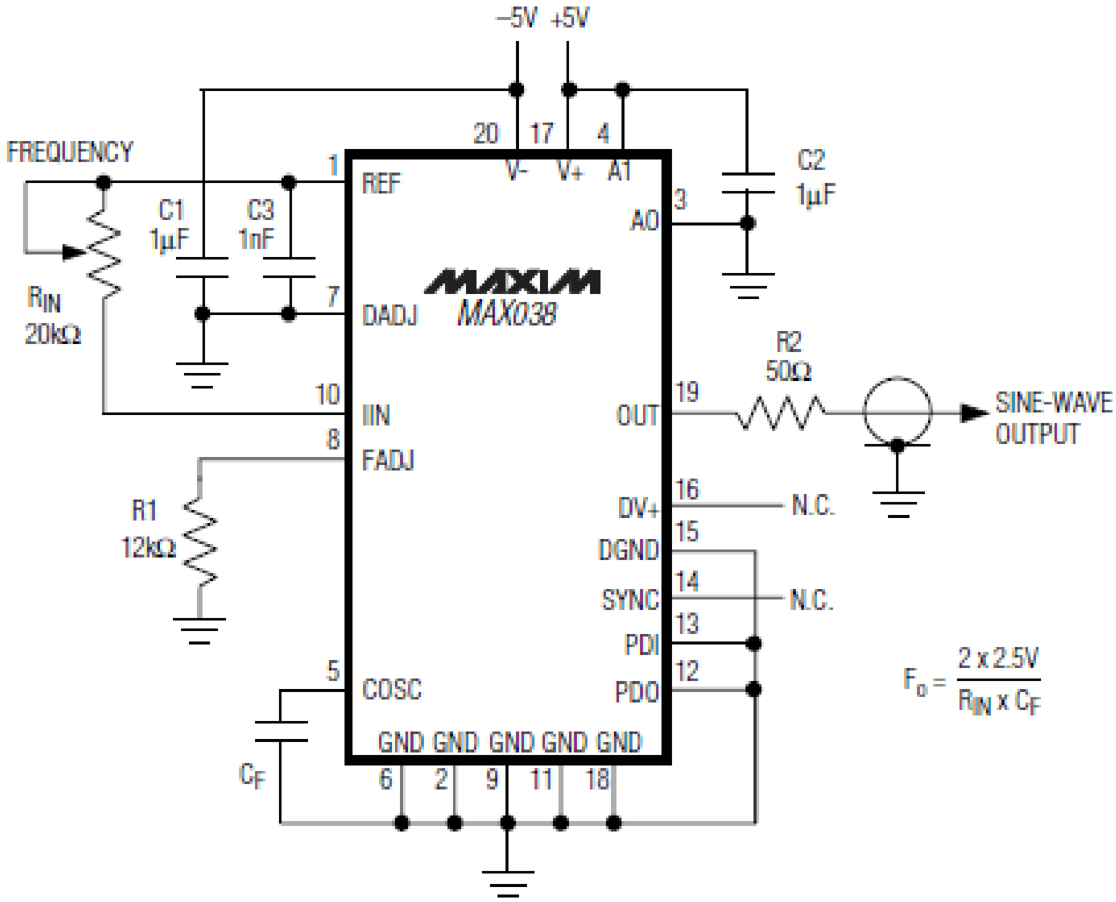
Below is the complete 2-Dimentional image of the proposed model.



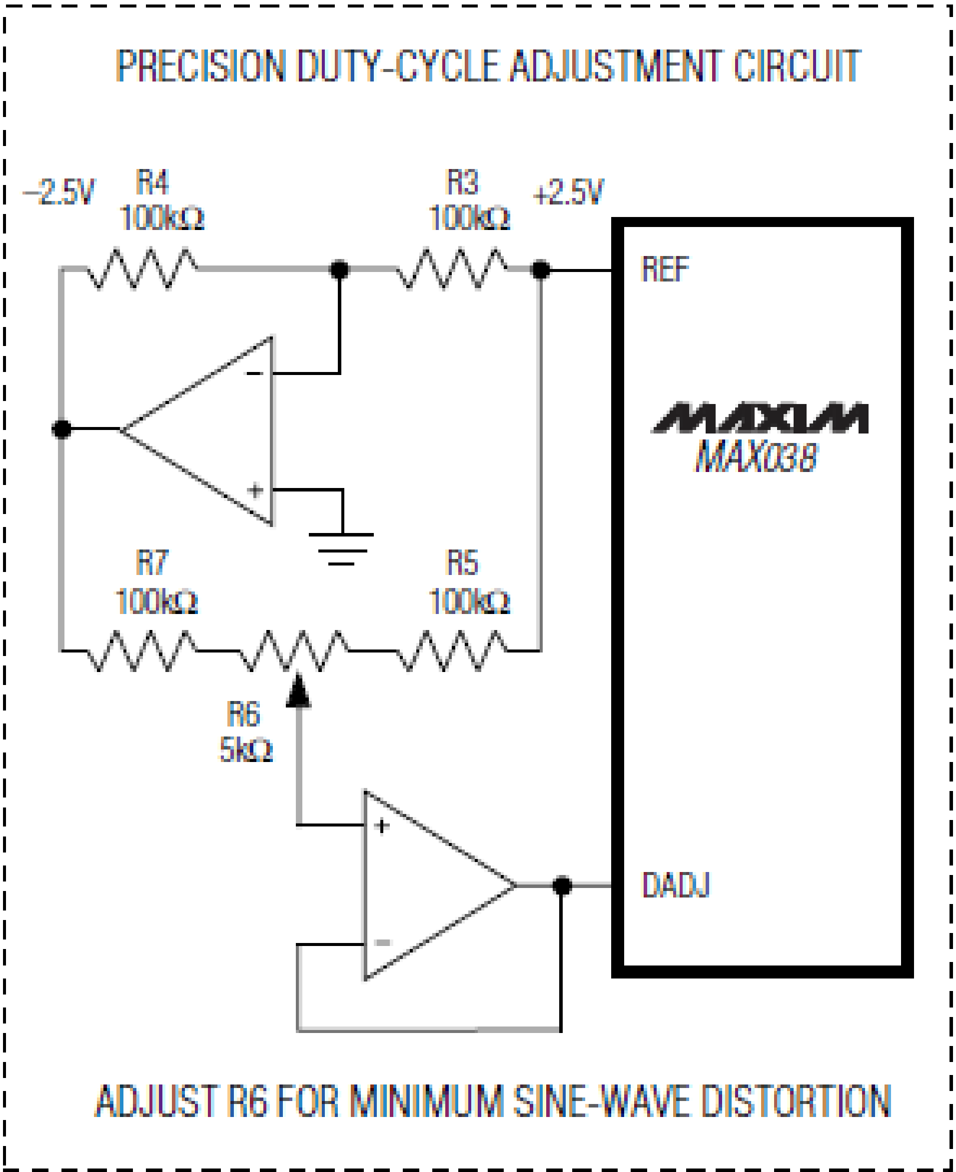
Ultrasound Transmission:

The Transmission Block consists of a signal generation circuit and a buffer circuit.

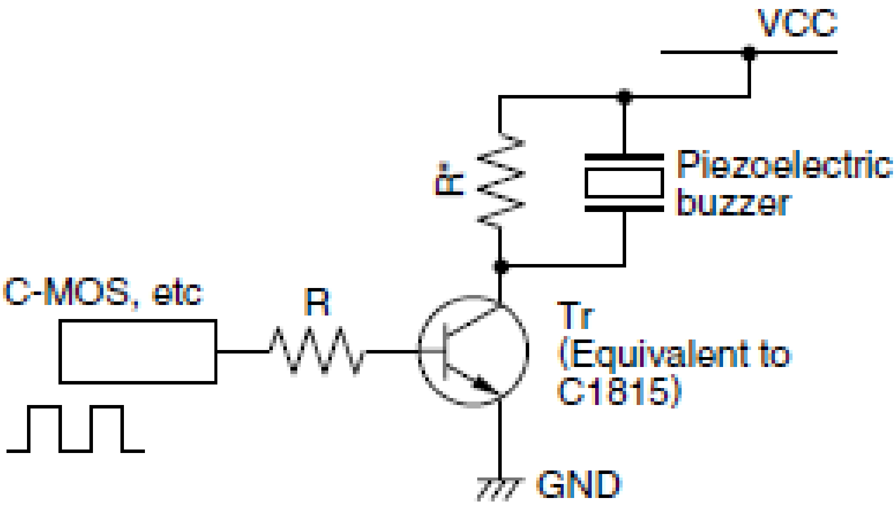
- Signal Generation: The signal Generation is achieved using the **MAX038** IC of MAXIM Company. The complete circuit is as follows.



- The MAX038 is a High Frequency Signal Generation IC
  - Depending on the signals at 3rd and 4th pin different waveforms are generated. Here 3rd to GND and 4th to +5v is generating sine wave. GND applied to both the pins will generate the square wave.
  - The Frequency of operation is flexible by adjusting the potentiometer at pin 1 and the capacitor at pin 5. The formula is shown in the figure.
  - There is a provision for duty cycle adjustment in the output, as the behaviour of crystals varies with it. Following is the circuit for the same



- The isolation of the transmitter and this IC is done by the Transistor circuit as shown below.



* Resistor to do charging and discharging to a piezoelectric element (Value of about 1kΩ is good efficiency).

➢ The above circuit acts as a buffer amplifier circuit.

The Pulses will be sent to the Transistor Buffer Circuit from the signal Generator IC and the amplification is done by isolating the piezoceramic electric discs from the IC.

RECEIVER:

Ultra Sound Attenuation sensor:-

To map the fat contents of the milk it is necessary to measure the mechanical wave/vibration`s attenuation through the milk. To achieve this we have used Piezo electric crystals. These crystals can generate mechanical vibrations of high frequency on application of electric signals (In this case square wave) of corresponding frequency and vice versa.
In this document we will focus on the circuits involved in the process.

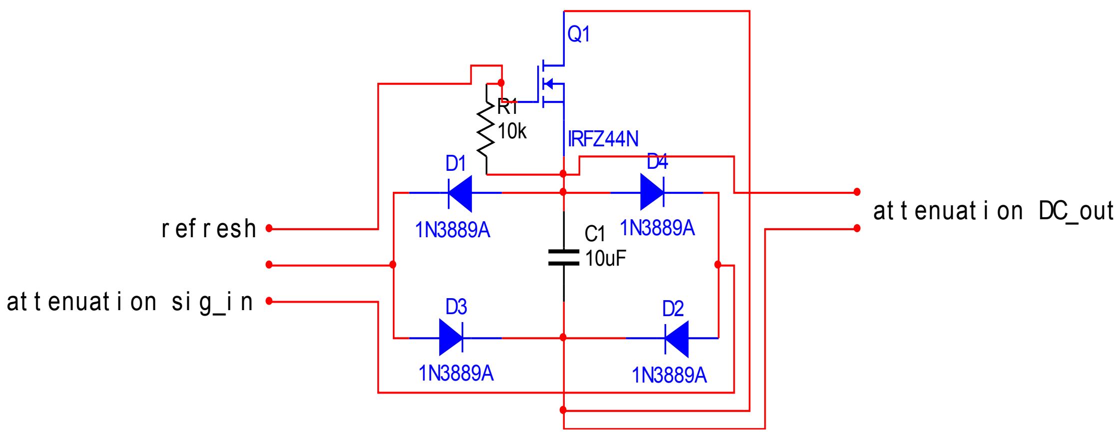


Figure 1 . Attenuation Rx

We have used germanium diodes to create a full wave rectifier. The output from the crystal will be a sinusoidal wave, to feed this data to the processor firm we need to convert it into corresponding DC value, hence we have used this rectifier arrangement.
We can also use readymade AC to DC IC`s for this purpose but since we are working at a high frequency ranges it renders the IC`s to be expensive.

The germanium diode will cause an internal voltage drop of about 0.2V unlike silicon diodes which is 0.7V volts hence we preferred using germanium diodes to obviate signal loses.

We have used a 10uF Capacitor to convert the ripples generated in the rectifier into a steady DC value. This DC value can be directly fed to the processor firm but since these firms will have very high impedance the capacitor might take a large time to discharge. To overcome this problem we have made an explicit discharge mechanism by using a MOSFET IRFZ44N(or 2N7000). This MOSFET is connected as shown in the circuit. When a 5V pulse is given the gate of this MOSFET the readings stored in the capacitor will be erased and when the pulse is retrieved the new readings get accrued.

Problems involved in this part: - The output from the crystal is very whimsical and uncertain, we think it's due to the presence of higher harmonics and we think we might need to band pass filter at the crystal end to overcome these problems.

Temperature sensor:-

We have used LM35 temperature sensor to achieve this part. Since the other calculations based on Fat contents like SNF, Proteins etc needs the values of subjected temperature. This circuit is necessary.

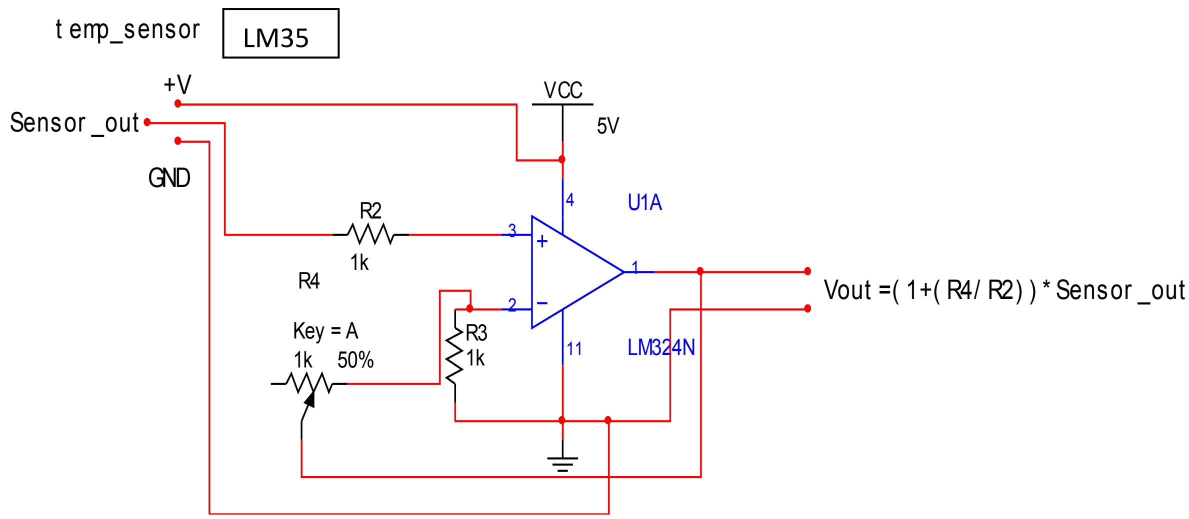


Figure 2. Temperature Sensor

The output from the sensor will be in scale of mV/c and to feed this data to the processor firm we need to amplify it hence we have used LM324 OPAMP as a non-inverting amplifier. The output from this stage can be directly fed into the processor firm.

Density sensor:-

As explained earlier we need the parameter readings like temperature, density etc. to find out the parameters like SNF, Proteins etc.
The main point to be noted is that we will be using on few grams of milk during the entire testing process. And we need a very sensitive sensor which can respond to weights in grams.

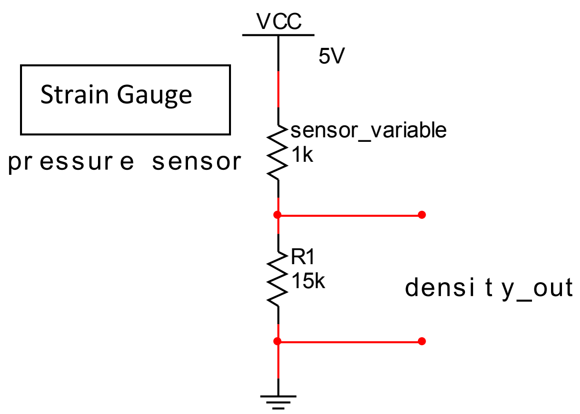


Figure 3. Density sensing circuit

To achieve this we have used a touch sensor. We can use the weight sensor itself directly but based on our attempt to procure sensitive weight sensor we learned that many weight sensors which are available in the markets have low resolution and they were found to be sensitive for weights in Kgs and they were very expensive.

On the other hand this touch sensor is aStrain Gauge network. It works on the principle of bridge balancing method. On application of force to this sensor the resistive bridge gets distorted and hence the net resistance gets modified. We can use this sensor as potentiometer although it seems misnomer it indeed works like that, where the force acting on it behaves like a potentiometer viper.

The circuit involves this sensor and a protective resistor connected in series with it. We apply potential to this arrangement. When a force is applied on the sensor, the resistance changes across the bridge this renders a change in voltage across the resistor. This variation was found to be linear with reference to the applied force.

The sample box which is designed to hold the milk is allowed to stand on the sensor the circuit gives some voltage which we can take it as an error or excess reading (ER). When the milk is poured in the sample box the circuit gives a new reading (NR). This NR-ER(correction) gives us the actually reading which corresponds to the weight of the milk. When we multiply this reading by coupling co-efficient we have the mass corresponding to the test milk.

We can know the volume of the milk by the geometry the milk box and then Mass/volume gives us the density.

Note : -

1) If there are any better and cheap sensors available to achieve this task we can implement it without any major change in the design.

Alternate experiment with Infrared Sensors

A) **Infrared sensor**:-

As an exploration, we have designed this infrared sensor circuit to see how it behaves with reference to the milk parameters. At a later point, we could explore using Infrared Sensor as a alternative to Ultrasound, for further researching purposes.

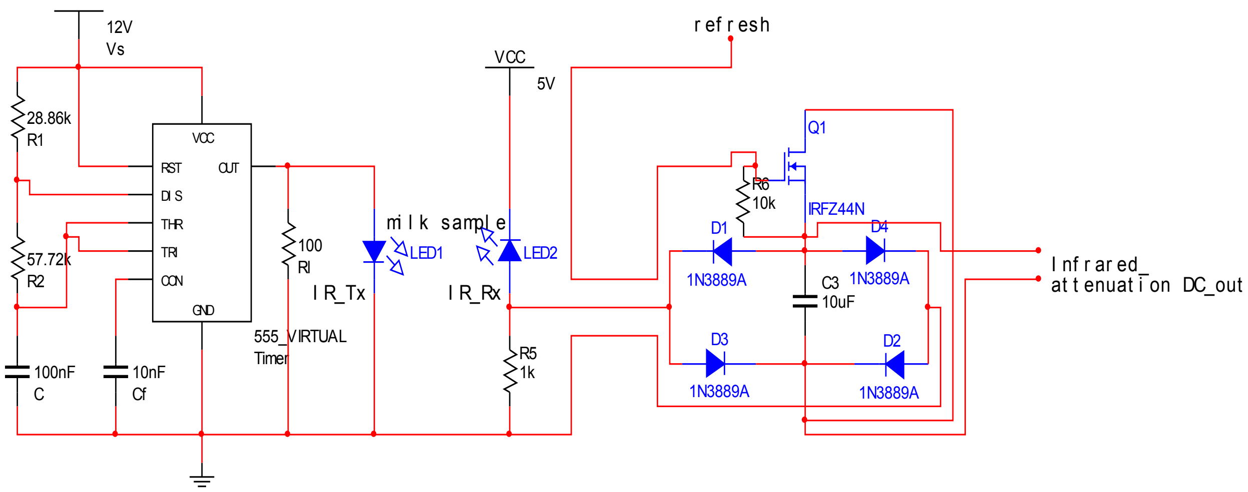


Figure 4. Infrared Tx and Rx circuit

- The circuit involves a 555 timer circuit in a multi vibrator mode to generate DC pulses of 100Hz.We can design the 555 based on our frequency requirement. These pulses or fed to the Infrared Red transmitter (IR tx) which transmits IR pulses of the corresponding frequency these pulses will be transmitted through the milk and will be received by an Infrared Receiver (IR rx). The signal received by the IR rx will be ripple in nature and hence to get a steady DC value we have again used a rectifier and a Capacitor to stabilize the output.

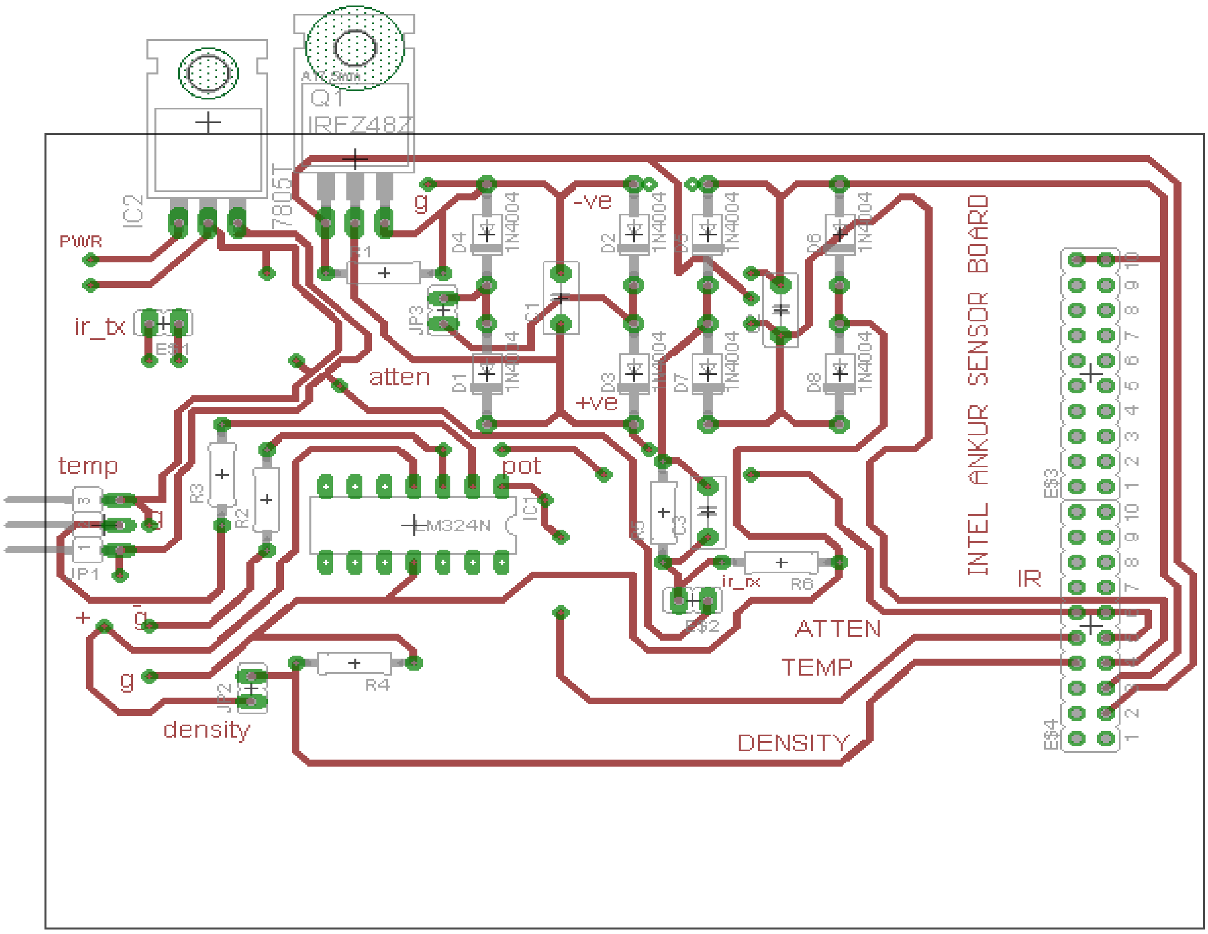
This network also has a transistor (MOSFET) across the capacitor to erase the readings quickly on acquire new readings across the capacitor. Again this DC value can be directly taken into the firm.

Note: - since we will be having all these sensors on a single PBC the gate signal needed to erase the readings stored across the capacitor by shorting it effectively can be achieved by using single signal line, I.e. the MOSFET involved in the Ultra Sound Attenuation receiver circuit and the Infrared receiver circuit can have a single gate line which on application of 5V will erase both the readings of US attenuation and Infrared attenuation. And we can immediate acquire a new reading just by removing this pulse.

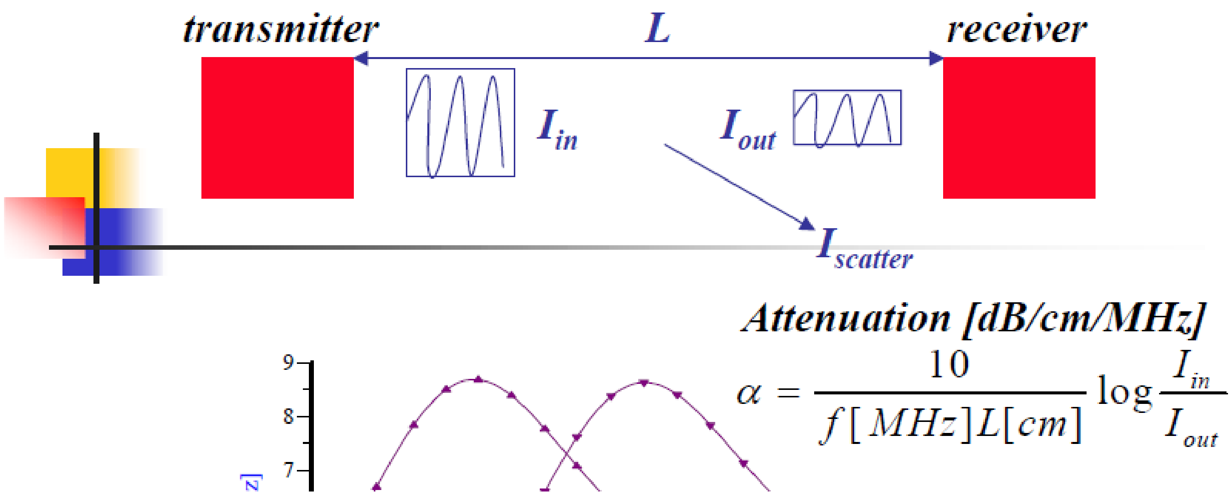
We can refer to this signal as refresh signal.

The Infrared attenuation readings can be used as an extra data from the 4th port of the output port. The attenuation seems to varying for different test sample. A clear relation about the variation is yet to be determined.

Receiver Board Design:-

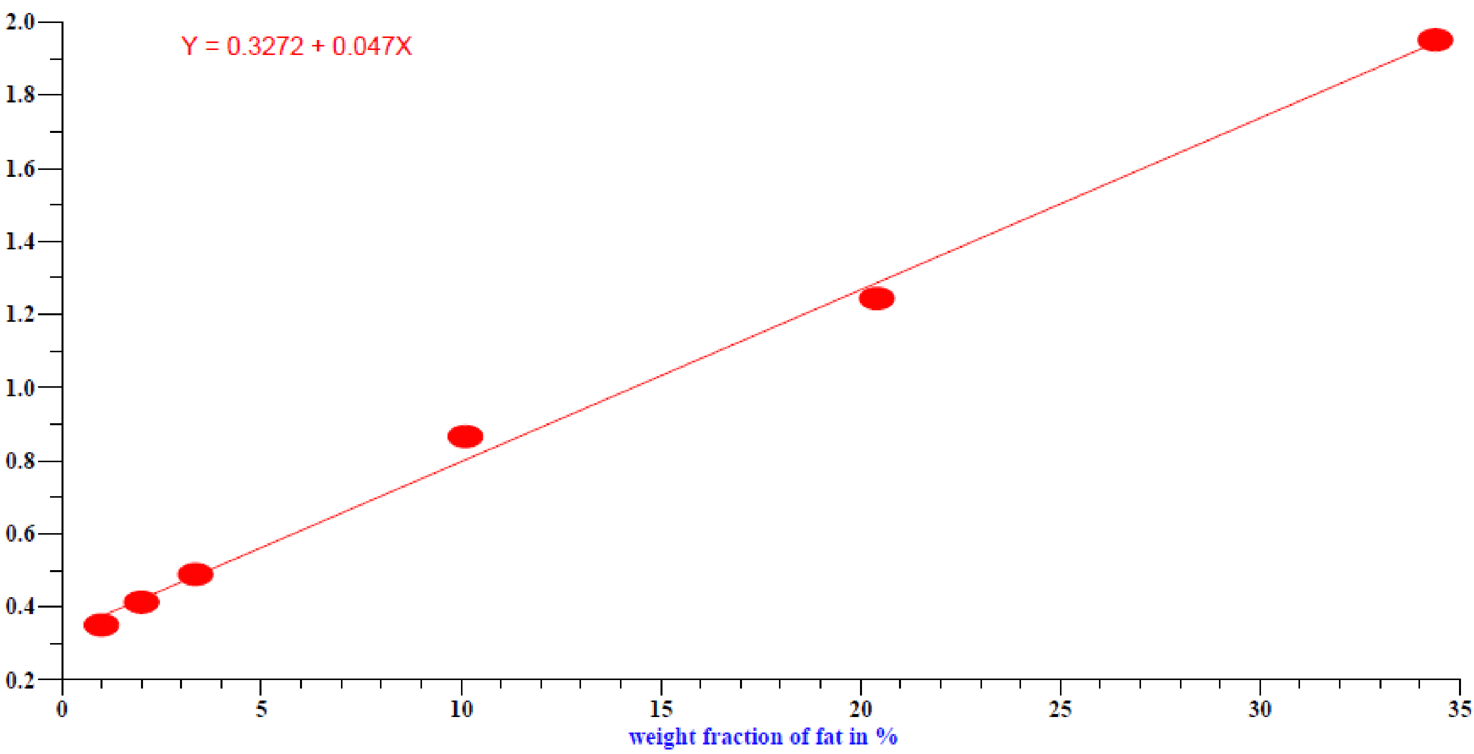


Coming on to some paperwork made, the portion of the program to be altered to feed the data onto the ds picAnalog pins has been identified.



$$\alpha = \frac{10}{f[MHz]L[cm]} \log \frac{I_{in}}{I_{out}}$$

- The equation to find the attenuation is found out and once the curve of attenuation and the fat from the reference instrument is known the equation for the curve will be fed into the program so that the processor can calculate all the parameters of the milk from the density(strain gauge pressure sensor), temperature (LM35), and fat (attenuation).



The above figure is a plot obtained straight from the paper and is for a 44 MHz sensor. This gives fat Vss Attenuation relation. Since the standard Milk Analyzer is available with the team, this can be used for bench marking purposes. Many profiles can be created for different grades of Milk, using our set up and this can be bench marked with the above analyzer.

Using these profiles, the quality of a new sample can be readily computed and displayed.