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Design of Lc Meter Using Arduino

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Abstract

All lovers that are embedded are familiar with multimeter which is a great tool for measuring voltage, current, resistance, etc. They can be easily measured by a multimeter. But sometimes with a normal multimeter, we need to measure inductance and capacitance that is not possible. There are a few special multimeters capable of measuring inductance and capacity, but they are expensive. We are already using Arduino to build Frequency Meter, Capacitance Meter and Resistance Meter. So today we are going to use Arduino to create an Inductance LC Meter. In this project, together with the frequency over 16x2 LCD display; we will show the inductance and capacitance values. In the circuit, a push button is provided to switch between the display of capacitance and inductance.

Keyword: *LCD, LC Meter, USB, Iinductor*

INTRODUCTION

Traditional LC meters measure the magnitude of voltage, current magnitude, and phase angle between current and voltage. Usually the first step in measuring reactive components such as inductivity L or capacitor C is to define the impedance vector. There are never sophisticated digital LC meters available while microcontroller boards are easier and efficient enough to do the job [1]. Measuring complex impedance is also quite a simple task with the Analog Devices microchip AD5933 impedance-to-digital converter.

With the I2C-compliant serial interface protocol, the widely used Arduino platform can easily maintain control of the impedance converter AD5933 [1]. Here, the main contribution is to extend the measurement range to lower impedance values as much as 1 -100. This is done using an additional 100 reference resistor in series with the unknown impedance and a corrective procedure.

Main Features

Our new Digital LC Meter is minimized and simple to work, since the Ar-duino board comes pre-amassed. It additionally has a superior LCD readout than the past form. It fits cozily inside a UB3 utility box and you ought to most likely form it for under $100 [2]. It offers programmed advanced measure-ment of both inductance (L) and capacitance (C) over a wide range and with 5-digit goals. Estimation exactness is superior to ±1% of perusing the vast majority of the reaches. It works from 5V DC, drawing a normal current of about 62mA, so it can keep running from a 5V USB supply (either mains or battery) or from an extra USB port on your PC [3].

We used Arduino in this LC Meter circuit chart to control the activity of the task. We used an LC circuit in this. This LC circuit includes an inductor and a condenser. We used operational enhancer in particular 741 to change the recurrence of sinusoidal reverberation to computerized or square wave. In order to get accurate yield recurrence, we need to apply negative

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supply to opamp [4]. So we used a backward extremity associated with a 3v battery, implying that 741 negative stick is associated with the battery negative terminal and the battery positive stick is associated with the ground of the rest of the circuit. See the circuit outline below for more lighting.

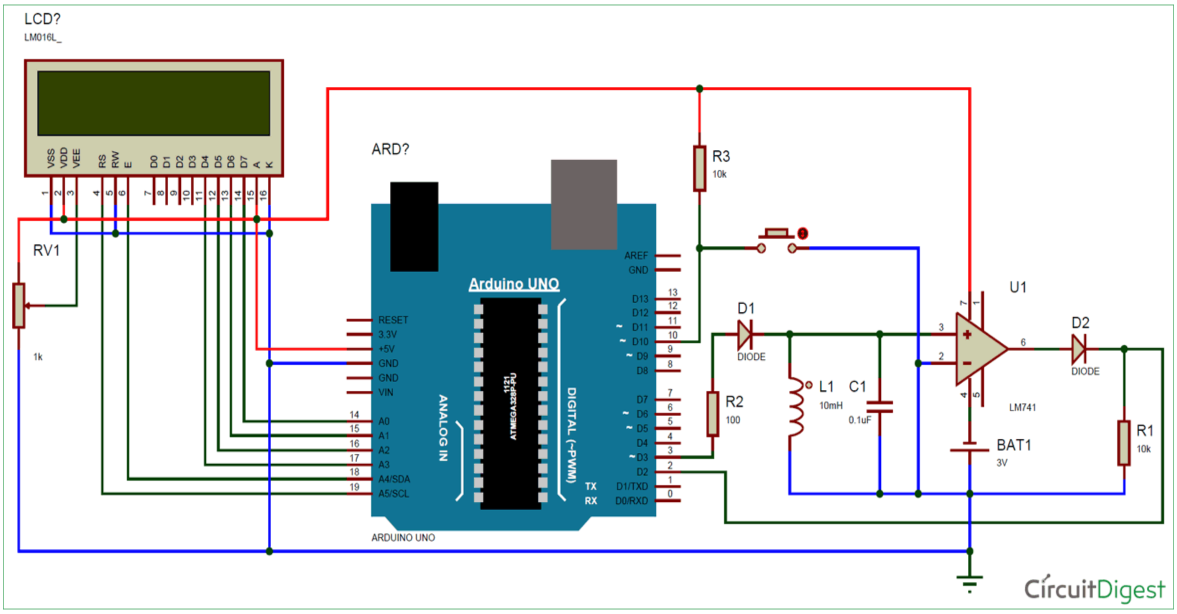

Figure 1: *Circuit Diagram*

We have a push catch here to change the operating method whether we estimate inductance or capacity. A16x2 LCD is used to indicate the recurrence of the LC circuit inductance or capacitance [3]. A 10k pot is used to control the LCD's brilliance. With the help of Arduino 5v supply, the circuit is powered and we can control the Arduino using a 5v USB or 12v connector.

Componentsused

1. Arduino Uno
2. 741 opamp IC
3. 3V battery
4. 100-ohm resistor
5. Capacitors
6. Inductors
7. 1n4007 diode
8. PCB

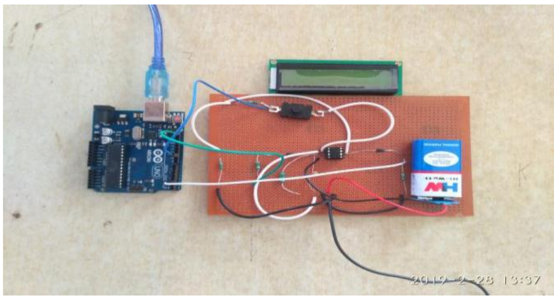

Figure 2: *Working of meter*

The meter's great execution depends on a shrewd estimation system grew right around 20 years prior by the late Neil Heckt in the USA. It utilizes a wide-go test oscillator and its frequecy is changed by interfacing the obscure inductance or capacitance you're estimating [5]. The subsequent change in recurrence is estimated by the microcontroller and used to compute the segment's esteem, which is shown straightforwardly on a little LCD board.

To accomplish solid wavering over a wide recurrence go, the test oscillator depends on a simple comparator with positive criticism around it. This arrangement has a characteristic tendency to waver, due to

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the high increase between the comparator's info and yield. Whenever control (+5V) is first connected, the comparator's sure information is held at +3.3V by the divider framed by the two 1 00ka resistors and the 1 00ka and 4.71S2 resistors [4]. At first, the voltage at the negative info is zero in light of the fact that the 10gF capacitor at this information needs time to charge by means of the 47kω resistor [5].

So with its positive info significantly more positive than the negative information, the comparator at first switches its yield high, to close +5V. When it does as such, the 10pF capacitor associated with the negative info starts energizing by means of the 471d/resistor and the voltage at this information rises. When it goes above +3.3V, the comparator yield switches low and the positive information is brought to 1.67V because of the 100kfl input resistor pulling the 100kC2 divider low.

The low comparator yield voltage is additionally coupled through the 10pF info capacitor to the tuned circuit shaped by inductor L1 and capacitor C1. This makes the tuned circuit "ring" at its resounding recurrence. Subsequently, the comparator and the tuned circuit currently work as an oscillator at that full recurrence. As a result, the comparator capacities as a negative obstruction over the tuned circuit, to drop its misfortunes and look after wavering. When this wavering is built up, a square rush of a similar recurrence is available at the comparator's yield and it is this recurrence (Four) that is estimated by the microcontroller.

By and by, before whatever else is associated with the circuit, Four, will basically compare to the resounding recurrence of the tuned circuit containing 1,1, C1 and any stray inductance and capacitance that might be related with them. At the point when control is first connected to the circuit, the microcontroller measures this recurrence (F1) and stores it in memory. It at that point stimulates reed transfer RLY1, which switches capacitor C2 in parallel with C1 and in this way brings down the oscillator recurrence. The miniaturized scale at that point measures and stores this new recurrence (F2). Next, the miniaturized scale utilizes these two frequencies in addition to the known estimation of C2 to precisely figure the estimations of both C1 and L1.

Calculating Frequency and Inductance

In this task we are going to measure inductance and capacitance by utilizing a LC circuit in parallel. This circuit is a like a ring or chime which begin reverberating at certain recurrence. At whatever point we apply a heartbeat, this LC circuit will begin resounding and this reverberation recurrence is in type of simple (sinusoidal wave) so we have to change over it in squire wave. To do this, we apply this simple reverberation recurrence to opamp (741 for our situation) that will change over it in squire wave (recurrence) at half of the obligation cycle. We are now measuring the recurrence by using Arduino and we can discover the inductance or capacitance by using some numerical estimation. We used the recurrence reaction equation given by the LC circuit.

```
f=1/ (2*time)
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where time is output of pulseIn() function
now we have LC circuit Frequency:

f=1/2*Pi* square root of (LC)

we can solve it to get inductance:

f2 = 1/ (4Pi2LC) L= 1/ (4Pi2 f2C)L = 1/(4* Pi * Pi * f * f * C)

As we previously referenced that our wave is sinusoidal wave so it has a similar timeframe in both positive and negative adequacy. Its methods the comparator will change over it into square wave having a half obligation cycle. With the goal that we can quantify it by using pulseIn () function of Arduino. This capacity will give us a timespan which can be effectively changed over into a recurrence by rearranging the timeframe. As pulseIn function measure just a single heartbeat, so now to get right recurrence we need to duplicate it by to 2. Presently we have a recurrence which can be changed over into inductance by utilizing the above equation.

Note: while estimating inductance (L1), capacitor (C1) esteem ought to be 0.1uF and keeping in mind that estimating capacitance (C1), inductor (L1) esteem ought to be 10mH.

Specifications of LC Meter

1. Inductance range:- 10nH to 100mH+
2. Capacitance range:-0.1 pF to 2.7pF+ (non-polarised only)
3. Measurement resolution:-five digits in either mode
4. Sampling rate:-approximately one measurement per second
5. Accuracy (when calibrated):- ±1% of reading, ±0.1pF or ±10nH
6. Supply voltage :- 5V DC @ <65mA (including backlit LCD)
7. Supply type :- USB charger or the USB port on a PC

ADVATAGES

1. Cost is less than regular LCR meter
2. Measuring range is more

CONCLUSION

Arduino-based LC– meter is portrayed, equipped for estimating huge capacitor just as little inductance esteems. The framework is work around the AD5933 microchip associated with Arduino by means of I2C interface. A little extra reference resistor of 100 Ω empowers estimation of little impedances utilizing revising strategy calculation**.**

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