IMPEDANCE MEASUREMENT INSTRUMENT

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ABSTRACT

Impedance has two main components, that is, resistance and reactance. Resistance is measured in DC mode whereas the reactance is measured in AC mode and hence it is affected by frequency of AC signal.

Impedance measurement device (LCR meter), or simply known as impedance meter, is used to detect the resistance and the reactance of a device using AC power supply. This project tackles the problem of traditional multimeter which can only measure the resistance of a device and the problem of an oscilloscope which needs to count the smallest division of phase angle and the smallest division of period of a signal. The impedance measurement device is working using the light bulb as a load and a function generator which generates sinusoidal signal with constant frequency to calculate the time difference between the peak voltage of a resistor and the peak voltage of light bulb or between the zero voltage of the resistor and zero voltage of the light bulb. The time difference between the light bulb and the 10 kohm resistor can be calculated using the relationship frequency is inversely proportional to the time period and the time difference is same with the time period. The LCD is used to show the impedance of the light bulb in rectangular form $Z= V_R + Vx\ j$, where V_R is the real part of the impedance and Vx is the imaginary part of the impedance. In polar form, phase difference between resistor's voltage and light bulb's voltage is used to calculate the V_R and the Vx of the light bulb. The phase angle between the light bulb and resistor is +86.4° and the light bulb's voltage waveform leads the resistor's voltage waveform. So, the light bulb is inductive equipment because its phase is +86.4° which is quite close to +90°. The phase difference between the light bulb and the pure inductor is about 3.6°. This method is suitable to measure equipment which is resistive, inductive, or capacitive or any combination of these.

After knowing the roles of the light bulb and the resistor, it is time to do with the project. There are some components, like PIC 16F877 which acts as voltage detectors of light bulb and resistor, and voltage regulator are used. The PIC 16F877 has the ADC converter which converts the signals detected by the voltage detectors to digital signals, then use it to count the time difference between the input voltage of light bulb and resistor and show the result in LCD. MikroC programming can command the PIC to read the input signals and do the calculations. Cost is the main problem faced in this project. Some parts like ADC converter and three phase motor are expensive. To solve this problem, I use built-in ADC converter of a PIC 16F877 and multimeter in my project.

This project meets the requirements.