01 Overview
A mixed-signal circuit is any circuit that has both analog circuits and digital circuits on a single circuit board. Mixed-signal circuits are mostly used in the circuitry of radios and in modern communication technologies. The digital circuit has the capability to provide logic and memory operations. The analog are electronic systems with a continuously variable signal, in contrast to digital electronics where signals usually take only two different levels. Also, it is highly desirable to physically separate sensitive analog components from noisy digital components. Therefore, the circuit board needs to be tested to many times to choose suitable integrated circuit (IC) components, such as an amplifier and an ADC converter. Also, if we place each IC, power and ground plane on a different position, it will affect the mixed-signal.
The goal of the project is generate the signal frequency <50MHz needs to be completed. The signal bandwidth is set between 10 kHz to 100 kHz. A stable signal needs to be completed to decrease the mixed-signal noise from digital component.

System Block Diagram

02 Methodology
Hardware:
The Analog part used a Variable-gain Amplifier and an Analog-To-Digital Converter (ADC) (12 bit, 14-bit). Variable-gain amplifier: it helps tame signals that exhibit wide dynamic range. Analog-To-Digital (12 bit, 14-bit): It offers a conceptually simple method for multiplying the sample rate of existing high-performing.
The digital part used a simple input and output signal Microcontroller board, since it can support a USB connection and a microcontroller. The project only for input and output signal, so, the Microcontroller board (Arduino Mega 2560) should be chosen simple and easy to control.
Software:
The project used “Eagle”, “MatLab” and “C” software. “Eagle”: It provides quality PCB design software with the features that get the job done. Also, it is easy to learn and enables professional PCB design. “MatLab”: It can analyze, visualize and explore data. Also, MATLAB has a wide range of applications, including signal and image processing, communications.
“C” software: In digital circuit, the Microcontroller board (Arduino Mega 2560) can be programmed with “C” software.

03 Testing & Result
Equipments: 1. Signal Generator 2. Logic analyzer 3. MATLAB
The following figure is the procedure of testing:

We designed 5 circuits and then drew the following schematic and layout. Above the figure is the one of the 5 circuits

For digital part: Microcontroller board (Arduino Mega 2560)