Programmable Digital Attenuator

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Abstract— **In RF signal processing circuits, RF active components get saturated at +13dB input power. Hence many times we need to control the gain of input signal before processing. The gain controlling of RF circuit is done using microcontroller. This amplifier circuit provide overall gain up to +10dB, due to this characteristic it can be used in all types of RF frequency circuits where required wide range of amplification and attenuation. This circuit design for A RF amplifier having frequency response from 50Hz to 3GHz with ±0.1dB accuracy.**

Keywords — Amplifier, Attenuator

I. INTRODUCTION

The main goal of this circuit is to control the strength of RF input signal. To getting this combination of analog RF circuit with digital microcontroller is used. In analog RF circuit, two types of IC used which are manufactured by minicircuit components. Amplifier and Attenuator IC which is a digital controlled variable gain amplifier with step of 0.5dB. By cascading ICs of attenuator and amplifier, going to reach goal of wide range of -94.5dB to +10dB. In other part of this circuit, used microcontroller to control the operation of this circuit .This microcontroller is also used to interface the input with circuit using LCD, keyboard and RS232 serial port. The ICs used in circuit attenuator and amplifier both has 6-bit digital control bits which are controlled using microcontroller.

II. BLOCK DIAGRAM

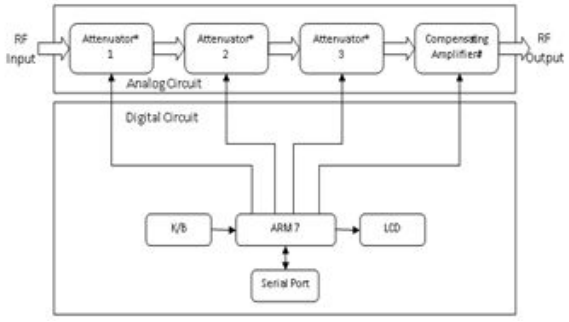

Fig.1 Block diagram of programmable digital attenuator.

Fig.1 shows the Block diagram of programmable digital attenuator. The RF signal is apply to the attenuator. To achieve maximum attenuation, attenuators are connected in series. These attenuators are controlled by microcontroller. Power supply section converts incoming DC into 5V and 3.3V DC. Keyboard is use as a input interface and LCD is used as a output interface for the microcontroller. By giving the input through keyboard, one can vary attenuation without removing RF attenuator from the system or circuit. The needed attenuation is apply through keyboard and it is displayed on Liquid Crystal Display. The attenuated signal is analyzed using signal analyzer. Since, RF output signal and the attenuation applied is known, one can find strength of input RF signal.

A. Attenuator

Fig.2 Attenuator.

The Attenuator is a digital step attenuator that provide range up to 31.5 dB in step of 0.5dB. The 6-bit parallel interface is used for control, operating on a single +3 volt power supply.

B. Amplifier

Fig.3 Amplifier.

The amplifier is used to increasing the strength of RF signal and it provide attenuation rang up to 31.5 dB in step of 0.5 dB using a 6-bit Parallel interface.

C. Keypad

Fig.4 4x4 Matrix Membrane Keypad.

The value of attenuation is applied through the keypad. The size of a keypad is defined by the number of keys required. When the two numbers are added together you get the number of I/O lines needed to read the keypad. The 16-button keypad provides a human interface.4 X 4 Matrix keypads use a combination of four rows and four columns to provide 16 states to the host device or microcontroller. Each key is a pushbutton, with one end connected to one row, and the other end connected to one column. a pair of pins are connected together and this pair is used to detect which button is pressed.

D. Liquid Crystal Display (LCD)

Fig.5 liquid crystal display (LCD)

A liquid crystal display (LCD) is a display or device that that uses the light modulating properties of liquid crystals (LCs).20x4 means it can be displayed that 20 characters each of the 4 rows of the 20x4 LCD, hence a total 80 characters can be displayed at a time

E. *Arm7 Controller*

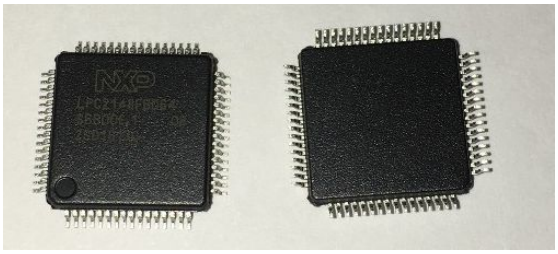

Fig.6 Arm7 controller.

The microcontroller is used for controlling the operation of this circuit .It operate on low power and it providing flexibility to the circuit. The microcontroller is based on a 32-bit arm7 architecture which provide a advance feature. The microcontroller is provide high-speed flash memory up to 512 kb. Serial communications interfaces USB 2.0, multiple UARTs, SPI, on-chip SRAM of 8 kb up to 40 kb, these feature makes devices very well suited for communication, soft modems and voice recognition.

CONCLUSION

Application of this circuit is to design a user controlled attenuator circuit which provide wide range of attenuation up to 94.5 db. To achieve this, RF attenuators and compensating amplifier each having a range up to 31.5 dB are cascaded and microcontroller control these attenuators. Use of microcontroller which provide us flexibility in varying the attenuation.

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